SHOUT
SHARE
IT

FOR THE PEOPLE
FOR EDVCATION
FOR SCIENCE

LIBRARY
OF
THE AMERICAN MUSEUM
OF
NATURAL HISTORY

Bound at
A.M.N.H.
1916

LIBRARY
OF THE
AMERICAN MUSEUM
NATURAL HISTORY

PROCEEDINGS

59.06(73)Xa

OF THE

SOCIETY FOR

EXPERIMENTAL BIOLOGY AND MEDICINE

VOLUME II.

1904–1905

EDITED BY THE SECRETARY

NEW YORK
AUGUST 1, 1905

16-71812-1Sec.1

PRESS OF
THE NEW ERA PRINTING COMPANY,
LANCASTER, PA.

OF THE
AMERICAN MUSEUM
OF NATURAL HISTORY

PREFACE.

At the meeting of the Society for Experimental Biology and Medicine, on April 19, the editor was instructed to present, in this volume, a brief biography of the founder and first president of the society. It is expected that the biography of Dr. Meltzer [page 5 (69)] will be followed, in succeeding volumes, by similar sketches of the lives of the future presidents of the society.

The constitution, as given on page 11 (75), includes the amendments that have been passed [page 99 (163)] since the publication of volume I.

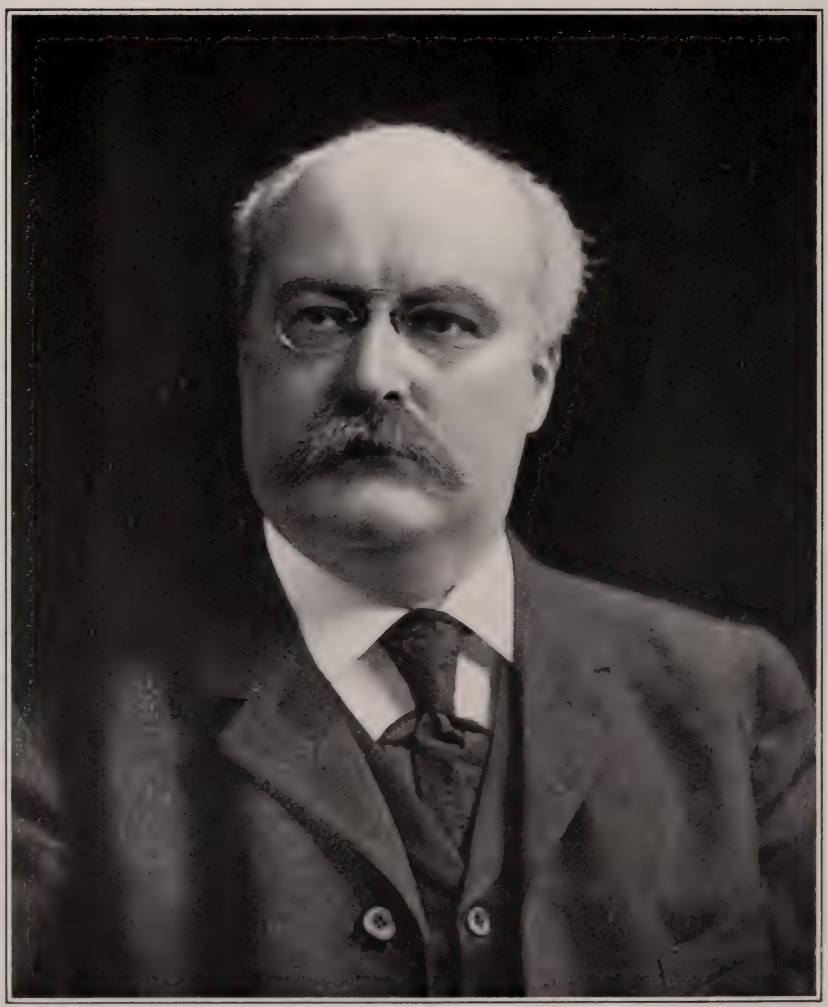
The numerals in parenthesis before the titles of the abstracts [page 19 (83)] indicate numerical positions in the entire series of communications presented before the society since its organization. These numerals are given on the assumption that some of the members desire to have bound together several (perhaps the first three) of these volumes. In such cases the numerical arrangement referred to, and that adopted for the index, will facilitate reference to the abstracts. The same is true of the page numerals in parenthesis.

The numerals in the index at the end of the volume correspond with those in parenthesis before the titles of the abstracts. None of them duplicate any of the numerals in the index of volume I.

August 1, 1905.

CONTENTS.

	Page.
Biography of Samuel James Meltzer	5 (69)
Constitution and by-laws	11 (75)
Register of names and addresses of the members . .	15 (79)
Classification of membership	17 (81)
Officers	18 (82)
Scientific proceedings :	
Abstracts of the reports	19 (83)
Recapitulation of the names of the authors and of the titles of the reports	91 (155)
Executive proceedings (quotations from the minutes) . .	97 (161)
Index of the scientific proceedings	101 (165)



S. J. Melton

SAMUEL JAMES MELTZER,

FOUNDER AND FIRST PRESIDENT (1903–'05) OF THE SOCIETY FOR EXPERIMENTAL BIOLOGY AND MEDICINE.

Samuel James Meltzer, the founder and first president of the Society for Experimental Biology and Medicine, was born at Traup, in the Government of Kovno, Russia, on the 22d of March, 1851. He attended schools in his native place and, later, at Königsberg in Prussia. In 1876 he entered the University of Berlin, where he pursued studies in philosophy under Paulsen, Benno Erdmann, Steinthal and others, and in medicine under von Helmholtz, Du Bois-Reymond, Kronecker, Virchow, Frerichs, Leyden and other teachers of that period. He graduated in medicine at Berlin in 1882. A year later he moved to New York and engaged in the active practice of medicine.

Of great importance in regard to his subsequent career is the fact that for about three years Dr. Meltzer worked on physiological subjects in the Physiological Institute of Berlin, especially in its "speziell physiologische Abtheilung," then under the direction of Prof. Hugo Kronecker. The chief subject of the studies of this period was an experimental analysis of the mechanism of swallowing, which led to the now well known Kronecker-Meltzer theory of deglutition. Although, for a period of more than twenty years after this time, circumstances made it impracticable for Dr. Meltzer to devote either his chief time or main energies to the laboratory, yet, as his published works show, he continued to carry on experimental work and to produce important papers bearing upon many topics in experimental and practical medicine, and in experimental biology.

The experimental part of his studies during the period of residence in New York was carried out in laboratories connected with New York medical schools — the pathological laboratory of Bellevue Hospital Medical College, and the pathological, physiological and physiologico-chemical laboratories at the College of

Physicians and Surgeons of Columbia University — and in his private laboratory at his residence, where the main part of his work was done. During the past year, since his association with the Rockefeller Institute for Medical Research, he has conducted experimental work in the laboratory of that institution.

In the quarter of a century of his activities and residence in New York many honors have come to him. He is a Fellow of the American Association for the Advancement of Science, the Academy of Sciences of New York, and the New York Academy of Medicine; member of the Association of American Physicians, the American Physiological Society, the Association of American Pathologists and Bacteriologists, and of other scientific and medical societies. For the last two years he was President of the American Gastro-Enterological Association, and he is now a member of the Council of the American Physiological Society, the Harvey Society and the Society for Experimental Biology and Medicine. He is consulting physician to the Harlem Hospital. At the International Congress of Arts and Sciences at St. Louis, in 1904, Dr. Meltzer was chairman of the section of Physiology. He was also chosen to inaugurate the "Harrington Lectureship" at the University of Buffalo (1904).

There follows a list of the more important papers contributed by Dr. Meltzer to medical and experimental biological science:

1881. — Ueber den Schluckmechanismus und dessen nervöse Hemmungen (with Hugo Kronecker). *Monatsber. der königl. Akad. der Wissensch. zu Berlin, Jan.* — On the propagation of inhibitory excitation in the medulla oblongata (with Hugo Kronecker). *Proc. of the Royal Society, No. 216.*

1882. — Geschlecht und Lungenvagus. *Centralbl. f. d. med. Wissensch.*

1883. — Die Irradiationen des Schluckcentrums und ihre allgemeine Bedeutung. *Arch. f. Anat. u. Physiol., Physiol. Abth.* — Der Schluckmechanismus, seine Erregung und seine Hemmung (with Hugo Kronecker). *Arch. f. Anat. u. Physiol., Physiol. Abth., Suppl. Festgabe.* — Schluckgeräusche in Scrobiculus cordis und ihre physiologische Bedeutung. *Centralbl. f. d. med. Wissensch.*

1884. — Zu den Schluckgeräuschen. *Berl. klin. Woch.* —

The behavior of the red blood corpuscles when shaken with indifferent substances (with W. H. Welch). *Journ. of Physiol., v.*

1888. — Ein Fall von Dysphagie nebst Bemerkungen. *Berl. klin. Woch.*

1889. — Carbolsäurevergiftung bei einem Kinde. *N. Y. med. Monatschr., Apr.* — Intubation in cases of foreign bodies in the air passages. *Med. Rec., Sep. 21.*

1890. — Ueber die Localization der Tuberkulose in der Lungenspitze. *Verhandl. des Xten internat. medic. Congresses.* — Ueber den Rhythmus der Athmung und des Herzschlages. *Ibid.* — On the self-regulation of respiration. *N. Y. Med. Journ., Jan. 18.* — Some remarks on my hypothesis of the self-regulation of respiration. *Ibid., Nov. 22.*

1891. — Theories of respiration. *Ibid., Aug. 8.*

1892. — On the respiratory changes of the intrathoracic pressure measured in the mediastinum posterior. *Journ. of Physiol., viii.* — Die Athemhemmenden und -anregenden Nervenfasern innerhalb des Vagus in ihren Beziehungen zu einander und zum Athemmechanismus. *Arch. f. Anat. u. Physiol.* — On the importance of vibration to cell life. *N. Y. Med. Journ., Dec. 24.*

1893. — On the self-regulation of the beat of the heart. *Ibid., May 13.* — On subphrenic abscess. *Ibid., June 24.*

1894. — Recent experimental contributions to the physiology of deglutition. *Ibid., Mar. 31.* — Ueber die fundamentelle Bedeutung der Erschütterung für die lebende Materie. *Zeitschr. f. Biol., xxx.* — Eine luftdichte Pleura-Kanüle. *Zeitschr. f. Instrumentenkunde, Dec.* — Ueber Myxoedem. *N. Y. med. Monatschr., April.*

1895. — On the thyroid therapy ; its history and its use in internal medicine. *N. Y. Med. Journ., May 25.* — An experimental study of direct and indirect faradization of the digestive canal in dogs, cats and rabbits. *Ibid., June 15.* — Das motorische Verhalten des Verdauungscanales Inductionsströmen gegenüber. *Centralbl. f. Physiol., ix.*

1896. — On absorption of strychnin and hydrocyanic acid from the mucous membrane of the stomach. *Journ. of Exp. Med., i.* — Experimental contribution to the study of the path by which fluids are carried from the peritoneal cavity into the circulation (with Isaac Adler). *Ibid.* — Ueber die Bedeutung der Lymph-

wege für die Resorption kleiner Flüssigkeitsmengen aus der Bauchhöhle (with Isaac Adler). *Centralbl. f. Physiol., x.* — Ueber die Unfähigkeit der Schleimhaut des Kaninchenmagens Strychnin zu resorbiren. *Ibid.*

1897. — The bactericidal action of lymph taken from the thoracic duct of a dog (with Charles Norris). *Journ. of Exp. Med., ii.* — A further experimental contribution to the knowledge of the mechanism of deglutition. *Ibid.* — On the paths of absorption from the peritoneal cavity. *Journ. of Physiol., xxii.* — The experiments on the faradization of the stomach of animals. A reply to Dr. Einhorn's criticism. *N. Y. Med. Journ., Apr. 24.* — Ueber den Verschluss der Glottis während des Schluckaktes. *Centralbl. f. Physiol., xi.* — Diseases of the thyroid and thymus glands, etc. *Hare's System of Practical Therapeutics., iv.*

1898. — On the nature of the cardio-pneumatic movements. *Amer. Journ. of Physiol., i.* — On the congenital hypertrophic stenosis of the pylorus in infants. *Med. Rec., Aug. 20.* — An experimental study on the direct inoculation of bacteria into the spleen of living animals (with T. M. Cheeseman). *Journ. of Exp. Med., iii.*

1899. — On the causes of the orderly progress of the peristaltic movements in the œsophagus. *Amer. Journ. of Physiol., ii.* — Otitis media and earache in lobar pneumonia of children. *Phila. Med. Journ., Aug. 5.* — On the influence of fasting on the bactericidal action of the blood (with Charles Norris). *Journ. of Exp. Med., iv.* — An experimental study of the absorption of strychnin in the different sections of the alimentary canal of dogs. *Amer. Journ. of Med. Sci., Nov.* — Inhibition. *N. Y. Med. Journ., May 13, 20 and 27.*

1900. — An experimental contribution to the knowledge of the toxicology of potassium chlorate. *Festschrift: Prof. Abraham Jacobi.* — The effect of shaking on the red blood cells. *Festschrift: Prof. William H. Welch.* — Is living animal tissue capable of neutralizing the effects of strychnin and venom? (with Gustav Langmann). *Med. News, Nov. 3.*—Some of the physiological methods and means employed by the animal organism in its continual struggle against bacteria for maintenance of life and health. Address in the symposium on bacteriology in health and disease at the Triennial Con-

gress of American Physicians and Surgeons. *Trans. of Congr. of Amer. Phys. and Surg., v.*

1901. — Poisoning by chlorates. Buck's *Ref. Handb. of Med. Sci., iii.* — Ueber den Einfluss der Peritonealhöhle auf das hämolytische Vermögen des fremden Serums. *Centralbl. f. Bakt., etc., xxx.* — Some experimental data on the significance of concentration and of multiplicity of area in hypodermic injections. *Journ. of Exp. Med., v.* — Hemolysis. *Med. Rec., Aug. 31.*

1902. — Paratyphoid. *N. Y. Med. Journ., Jan. 25.* — The effects of subminimum doses of strychnin in nephrectomized rabbits (with William Salant). *Journ. of Exp. Med., vi.* — The rôle of inhibition in the normal and in some of the pathological phenomena of life. *Med. Rec., June 7.* — The influence of alcohol upon infection and its use in the treatment of acute infectious diseases. Read at the annual meeting of the Massachusetts Medical Society, June 11. *Amer. Med., iv.* — The contraction of the ilio-psoas muscle as an aid in the diagnosis of the contents of the iliac fossa. *N. Y. Med. Journ., July 19.*

1903. — The question of fixation of strychnin in animal tissue (with Gustav Langmann). *Journ. of Med. Research, ix, p. 19.* — The influence of nephrectomy upon absorption (with William Salant). *Ibid., p. 33.* — Studies on the influence of artificial respiration upon strychnin spasms and respiratory movements (with William J. Gies). *Amer. Journ. of Physiol., ix, p. 1.* — A study of the vasomotor nerves of the rabbit's ear contained in the third cervical and in the cervical sympathetic nerves (with Clara Meltzer). *Ibid., p. 57.* — The share of the central vasomotor innervation in the constriction caused by intravenous injections of suprarenal extract (with Clara Meltzer). *Ibid., p. 147.* — Some observations on the effects of agitation upon arbacia eggs. *Ibid., p. 245.* — On the effects of subcutaneous injection of the extract of the suprarenal capsule upon the blood-vessels of the rabbit's ear (with Clara Meltzer). *Ibid., p. 252.* — On a difference in the influence upon inflammation between section of the sympathetic nerve and removal of the sympathetic ganglion (with Clara Meltzer). *Journ. of Med. Research, x, p. 135.*

1904. — Edema. D. W. Harrington lectures, delivered at the University of Buffalo, Nov. 30, Dec. 1 and 2, 1903. *Amer. Med.,*

viii (Nos. 1, 2, 4 and 5). — Bemerkungen über Gastralgie, Magenkolik und Kolik in Allgemeinen. *Arch. f. Verdauungskrank., ix, p. 450.* — Studies on the paradoxical pupil-dilatation caused by adrenalin (with Clara Meltzer Auer). *Amer. Journ. of Physiol., xi, p. 28.* — Myelopathic albumosuria. *Med. Rec., June 18.* — The effect of ligation upon the vital staining of nerves. *Proc. Soc. for Exp. Biol. and Med., i, p. 22.* — On the clotting of the blood of nephrectomized rabbits (with William Salant). *Journ. of Med. Research, xii, p. 63.* — The effect of suprarenal extract upon the pupils of frogs (with Clara Meltzer Auer). *Amer. Journ. of Physiol., xi, p. 449.* — The domain of physiology and its relations to medicine. Chairman's address before the Section of Physiology of the World's Congress of Arts and Sciences, St. Louis, Sep. 23. *Amer. Med., viii, p. 755; Science, N. S., xx, p. 557.* — The influence of suprarenal extract upon absorption and transudation (with John Auer). *Trans. of Ass. of Amer. Phys.* — The effect of pilocarpin hydrochlorate in strychnin poisoning (with William Salant). *Journ. of the Amer. Med. Ass., Dec. 31.*

1905. — On the rate of absorption from intramuscular tissue (with John Auer). *Journ. of Exp. Med., vii.* — Studies of the toxicity of bile: I. The effects of intravenous injections of bile upon the blood pressure (with William Salant). *Ibid.* — The men we lost. President's address, delivered at the opening of the eighth annual meeting of the American Gastro-Enterological Association, Academy of Medicine, New York, April 24. *Med. News, July 22.*

(Publications after August 1 are not included.)

CONSTITUTION AND BY-LAWS.

CONSTITUTION.

[As adopted February 25, 1903, and amended April 20, 1904, and May 24, 1905.] *

Article I. Name.

The name of this organization shall be The Society for Experimental Biology and Medicine.

Article II. Object.

The object of this Society shall be the cultivation of the experimental method of investigation in the sciences of animal biology and medicine.

Article III. Membership.

Section 1. *Eligibility.* — Any person who has accomplished a meritorious original investigation in biology or medicine by the experimental method shall be eligible to membership.

Section 2. *Classification.* — The term "resident members" shall refer, in this constitution, to those members whose experimental work shall be done within the limits of "Greater New York"; "non-resident members," to those whose scientific work shall be done outside of "Greater New York."

Section 3. *Obligations.* — A. Every member shall be expected to conduct an experimental investigation and give public notice of it, at least once in two years.

B. *Resident* members shall be required either to attend, every two years, at least three meetings of the Society, or to present in person, at least once every two years, a report of their experimental researches.

C. Each *non-resident* member shall be required to present in person, at least once every two years, a communication containing the results of an experimental investigation, or to send to the

* The amendments adopted May 24, 1905 are indicated by heavy-faced letters.

President within that time, such a communication for presentation at a regular meeting of the Society.

D. It shall be the duty of each member to present to the Librarian **one** copy of every publication of his researches.

E. Non-compliance with any of these requirements carries with it forfeiture of membership, unless an acceptable explanation is offered to the Council.

F. **Any member of this Society who may consent to the use of his name in any way that would aid in increasing the sale of any patent medicine, proprietary food preparation, or any similar product known to be of doubtful value, shall forfeit his membership.**

Section 4. *Nomination and Election.* — A. Candidates for membership must be nominated by three members.

B. After their eligibility has been determined by the Council, nominees may be voted for at any meeting succeeding that at which their names were presented.

C. A three-fourths vote of the ballots cast shall elect.

Section 5. *Expulsion.* — Any member may be expelled by a three-fourths vote of the total membership.

Article IV. Meetings.

Section 1. *Time.* — The Society shall hold regular meetings at least once every two months during the academic year.

Section 2. *Annual Business.* — The first meeting held in the calendar year shall be the annual business meeting.

Section 3. *Program.*—The program of the meetings shall consist of (A) brief presentations, in elementary form, of the essential points of experimental investigations, preferably demonstrations of actual experiments; and (B) of brief reports of important facts recently discovered in the sciences of biology and medicine or allied natural sciences.

Article V. Officials.

Section 1. *Officers.* — The officers shall be a President, a Vice President, a Secretary, a Librarian and a Treasurer.

Section 2. *Council.* — The officers shall constitute the Council of the Society. **Ex-Presidents of the Society shall be ex-officio permanent members of the Council.**

SECTION 3. *Nomination and Election.* — A. Nominations of officers shall be made by the members in the session immediately preceding the annual business meeting.

B. Election of officers shall be by ballot at the annual business meeting.

C. A plurality of the votes cast shall elect.

SECTION 4. *Term of Office.* — The term of office shall be one calendar year.

SECTION 5. *Duties.* — A. The duties of the officers shall be such as usually devolve on them individually, and also collectively as an executive committee.

B. The Council shall promptly investigate and report its findings on the eligibility of candidates for membership.

C. The Librarian shall receive and preserve copies of the publications of the experimental investigations of the members, and shall keep an official record of them. (**Roll call provision withdrawn.**)

ARTICLE VI. DUES.

The annual dues shall be **Two Dollars** (**$2.00**),* unless otherwise determined by the Council.

Non-payment of dues for three consecutive years carries with it forfeiture of membership.

ARTICLE VII. QUORUM.

A majority of the members resident in "Greater New York" shall constitute a quorum for the transaction of business.

ARTICLE VIII. BY-LAWS.

By-laws may be adopted at any meeting by a majority vote.

ARTICLE IX. AMENDMENTS.

SECTION 1. Proposed amendments to the constitution must be endorsed by at least three members, at a regular meeting, and may be voted on at a succeeding meeting.

SECTION 2. It shall be the duty of the Secretary to give all members due notice of intended amendments.

SECTION 3. A two-thirds vote of the total membership, **or a unanimous vote of the members present,** shall be required for the adoption of an amendment.

* Raised from one dollar to two dollars by the council, February 15, 1905.

BY-LAWS.

[Adopted February 25, 1903, and amended May 24, 1905.]*

I. *Meetings.* — A. The meetings shall be held on the third Wednesdays of October, December, February, April and May.

B. The meetings shall be opened at 8:15 p. m., and shall be closed at 10:30 p. m.

C. When possible the meetings shall take place in suitable laboratories.

II. *Time Allowed for Reports and Discussions.* — A. The time allowed for making individual communications, except demonstrations of experiments, shall be restricted to ten minutes.

B. Not more than five minutes shall be allowed to a member for the discussion of any communication.

III. *Order of Procedure to be followed at the regular meetings:*

A. Call to order.
B. Reading of minutes.
C. Report of council.
D. Scientific program.
E. Executive program.
- **a. Reports of committees.**
- **b. Unfinished business.**
- **c. Election of members.**
- **d. Nominations for membership.**
- **e. New business.**

F. Adjournment.

* The additions made on May 24, 1905, are indicated by heavy-faced letters.

REGISTER OF NAMES AND ADDRESSES OF THE MEMBERS.

ABBOTT, ALEXANDER C.....University of Pennsylvania.
ABEL, JOHN J.....Johns Hopkins University.
ADAMI, J. GEORGE.....McGill University.
ADLER, ISAAC.....22 East 62d St., New York.
ATKINSON, JAMES P.....Department of Health, New York.
AUER, JOHN.....Rockefeller Institute for Medical Research.

BENEDICT, FRANCIS G.....Wesleyan University.
BROOKS, HARLOW.....N. Y. University and Bellevue Hospital Medical College.
BURTON-OPITZ, RUSSELL.....Columbia University.
BUXTON, B. H.....Cornell Medical College.

CALKINS, GARY N.....Columbia University.
CANNON, WALTER B.....Harvard Medical College.
CARLSON, A. J.....University of Chicago.
CONKLIN, E. G.....University of Pennsylvania.
CRAMPTON, HENRY E.....Columbia University.
CRILE, GEORGE W.....Western Reserve Medical College.
CUNNINGHAM, RICHARD H.....Columbia University.
CUSHING, HARVEY W.....Johns Hopkins University.
CUSHNY, ARTHUR R.....University College, London.

DAVENPORT, CHARLES B.....Carnegie Institution's Station for Experimental Evolution.
DUNHAM, EDWARD K.....N. Y. University and Bellevue Hospital Medical College.

EMERSON, HAVEN.....Columbia University.
ERLANGER, JOSEPH.....Johns Hopkins University.
EWING, JAMES.....Cornell Medical College.

FIELD, CYRUS W.....Department of Health, New York.
FLEXNER, SIMON.....Rockefeller Institute for Medical Research.
FOLIN, OTTO.....McLean Hospital, Waverly, Mass.

GIES, WILLIAM J.....Columbia University.

HARRISON, R. G.....Johns Hopkins University.
HATCHER, R. A.....Cornell Medical College.

Hawk, Philip B.....University of Pennsylvania.
Hektoen, Ludvig .....University of Chicago.
Henderson, Yandell.....Yale University.
Herter, Christian A.....Columbia University.
Hiss, Philip H.....Columbia University.
Howell, William H.....Johns Hopkins University.
Huber, G. Carl.....University of Michigan.
Hunt, Reid.....Public Health and Marine-Hospital Service of the United States — Hygienic Laboratory.

Jackson, Holmes C.....Albany Medical College.
Jennings, H. S.....University of Pennsylvania.
Jordan, E. O.....University of Chicago.

Lee, Frederic S.....Columbia University.
Levene, P. A.....Rockefeller Institute for Medical Research.
Levin, Isaac.....1883 Madison Avenue, New York.
Loeb, Jacques.....University of California.
Loeb, Leo.....University of Pennsylvania.
Lusk, Graham.....N. Y. University and Bellevue Hospital Medical College.

Macallum, A. B.....University of Toronto.
MacCallum, W. G.....Johns Hopkins University.
Mandel, Arthur R .....N. Y. University and Bellevue Hospital Medical College.
Mathews, Albert P.....University of Chicago.
Meltzer, S. J.....Rockefeller Institute for Medical Research.
Mendel, Lafayette B.....Yale University.
Morgan, T. H.....Columbia University.
Murlin, J. R.....N. Y. University and Bellevue Hospital Medical College.

Noguchi, Hideyo.....Rockefeller Institute for Medical Research.
Norris, Charles .....Bellevue Hospital, New York.
Novy, Frederick G.....University of Michigan.

Oertel, Horst.....City Hospital, New York.
Opie, Eugene L.....Rockefeller Institute for Medical Research.

Park, William H.....N. Y. University and Bellevue Hospital Medical College.
Parker, G. H.....Harvard University.
Pearce, Richard M.....Albany Medical College.
Pfaff, Franz.....Harvard Medical College.
Porter, W. T.....Harvard Medical College.
Pratt, Joseph H.....Harvard Medical College.

Richards, Alfred N.....Columbia University.

SALANT, WILLIAM.....Columbia University.
SHERMAN, H. C.....Columbia University.
SMITH, THEOBALD.....Harvard Medical College.
SOLLMANN, TORALD .....Western Reserve Medical College.
STEWART, G. N.....University of Chicago.
STILES, PERCY G.....Massachusetts Institute of Technology.
STOOKEY, LYMAN B.....University of Southern California.
SWEET, J. EDWIN.....Rockefeller Institute for Medical Research.

TAYLOR, ALONZO E.....California University.
TORREY, J. R.....Cornell Medical College.

VAUGHAN, VICTOR C.....University of Michigan.

WADSWORTH, AUGUSTUS B.....Columbia University.
WALLACE, GEORGE B.....N. Y. University and Bellevue Hospital Medical College.
WARTHIN, ALFRED S.....University of Michigan.
WELCH, WILLIAM H.....Johns Hopkins University.
WILLIAMS, HERBERT U.....University of Buffalo.
WILSON, EDMUND B.....Columbia University.
WOLF, C. G. L.....Cornell Medical College.
WOODWORTH, ROBERT S.....Columbia University.

YATSU, NAOHIDÊ.....463 Manhattan Ave., New York.

Total number of members at the close of the academic year 1904–1905...87.

CLASSIFICATION OF MEMBERSHIP.

I. CHARTER MEMBERS		19
Resident	17	
Non-resident	2	
II. ELECTED MEMBERS		70
Active	68	
Resigned	2	
III. ACTIVE MEMBERS		87
Resident	42	
Ron-resident	45	

OFFICERS.

Second year: February, 1904–February, 1905.

President ..... S. J. Meltzer.
Vice President ..... James Ewing.
Librarian ..... Graham Lusk.
Treasurer ..... Gary N. Calkins.
Secretary ..... William J. Gies.
Council — President, vice president, librarian, treasurer and secretary.

Third year: February, 1905–February, 1906.

President ..... Edmund B. Wilson.
Vice President ..... Edward K. Dunham.
Librarian ..... Graham Lusk.
Treasurer ..... Gary N. Calkins.
Secretary ..... William J. Gies.
Council — S. J. Meltzer, Edmund B. Wilson, Edward K. Dunham, Graham Lusk, Gary N. Calkins and William J. Gies.

SCIENTIFIC PROCEEDINGS.

Abstracts of Reports.[1]

Eighth meeting.[2]

Physiological Laboratory of Columbia University, at the College of Physicians and Surgeons. October 19, 1904. President Meltzer in the chair.

1 (47).[3] "**The accommodation of the eye,**" with demonstrations: **Theodor Beer,** of the University of Vienna. (By invitation.)

Two principles are realized in the accommodation of an eye that is constructed as a "camera obscura": (1) Change of curvature of refracting surfaces, principally the lens; (2) change of distance between refracting mediums and image screen, principally distance between lens and retina.

1. There is only *increase* of curvature, principally of the anterior surface of the lens, during active accommodation. We observe it in mammals, birds, and reptiles (lizards, crocodiles, turtles, a few snakes). Experiments were made before the society to show the increase of curvature of the lens in the eye of the water-turtle — proof of Helmholtz's theory of accommodation.

2. Accommodation by change of the distance between lens and retina is possible in two directions: (*a*) In cephalopods and fishes, which are normally shortsighted, accommodation for objects at a distance is effected by a movement of the lens toward the retina. In the eye of the fish there is a muscle *Musculus retractor lentis* (Beer) which draws the lens toward the retina; (*b*) in amphibia and most of the snakes, the lens is moved toward the cornea, away from the retina, by changes of the intraocular pressure.

[1] The authors of the reports have written the abstracts. The editor has made a few abbreviations and minor alterations in some of them.

[2] Reprinted from *Science*, 1904, xx, p. 677; *American Medicine*, 1904, viii, p. 931; *Medical News*, 1904, lxxxv, p. 1143.

[3] See Preface.

2 (48). **"Preliminary communication on the composition of the liver after subcutaneous injections of liver extracts": P. A. LEVENE and L. B. STOOKEY.**

About two years ago the authors observed that it was possible to increase the resistance of rabbit blood against trypsin by treating the animal to subcutaneous injections of pancreatic extract. It seemed probable that the resistance of organs against other proteolytic enzymes than trypsin could be increased in an analogous manner.

Rabbits were treated with saline liver extracts. The autolytic powers of the livers of such animals were compared with the autolytic powers of the livers of normal animals. It was found that the autolytic power of the organ was not diminished by the treatment referred to. It was also noted that the organs of the treated animals contained smaller proportions of nitrogen than the livers of the control animals, and further, that the proportions of noncoagulable proteins and of nonbasic nitrogen were higher than in the controls.

In order to accurately interpret the findings, the figures for composition of the livers were compared. It was noted that the amounts of water and carbohydrates were not affected by the treatment, while the proportion of ether-extract was higher in the organs of the treated animals than in those of the control animals. The appended table gives the data of nine experiments, on as many animals.

Condition of Rabbit.	Weight of Rabbit. Grams.	Weight of Liver. Grams.	Gram Ethereal Extract per Gram of Liver.	Gram Carbohydrate as Sugar per Gram of Liver.	Per Cent. of Water in Liver.	Nitrogen as c.c. of $\frac{n}{10}$ NH_4OH per Gram of Liver.	Liver Before Digestion. Per Cent. of Total Nitrogen as c.c. of $\frac{n}{10}$ NH_4OH.		Liver after Digesting 24 Hours. Per Cent. of Total Nitrogen as c.c. of $\frac{n}{10}$ NH_4OH.	
							Zinc Sulfate Filtrate.	Phosphotungstic Filtrate.	Zinc Sulfate Filtrate.	Phosphotungstic Filtrate.
Normal						20.0	13.5	9.9	18.0	12.3
"						18.0	10.0	8.5	24.0	19.5
"						19.0	10.1	8.7	18.9	13.2
"						19.0	12.6	10.4	18.9	15.4
"	2050	75	0.026	0.078	72.0					
"	2250	87	0.023	0.107	69.2	19.8				
Treated						16 0	19.5	16.8	28.5	22.5
"	1710	66	0.048	0.055	71.5	16.8	21.5	19.7	30.7	26.7
"	2800	76	0.056	0.071	70.8	17.3	20.7	15.6	29.6	23.2

3 (49). **"The transformation of negatively heliotropic animals (Gammarus pulex) into positively heliotropic animals by chemical means"**: **JACQUES LOEB**. (Presented by **SIMON FLEXNER**.)

After it had been proved that the heliotropism of animals and plants is identical, it seemed desirable to find means by which positively heliotropic animals could be transformed into negatively heliotropic ones, and vice versa. Groom and Loeb found that such a transformation was possible in the nauplii of *Balanus perforatus* at Naples by the influence of light, inasmuch as these animals were positively heliotropic in very weak light and negatively heliotropic in strong light.[1] Later Loeb found that the marine *Copepods* and young larvas of *Polygordius* became positively heliotropic on lowering the temperature as well as on increasing the concentration of the seawater, while they became negatively heliotropic under the opposite influences.[2] Moreover Loeb observed that negatively heliotropic *Copepods* can be made positively heliotropic by mechanical agitation,[2] and Miss Towle showed that the sign of heliotropism in *Cypridopsis* can be reversed by contact with solid bodies.[3] Holmes made the discovery that the positively heliotropic terrestrial *Amphipods*, e. g., *Orchestia agilis*, become negatively heliotropic when thrown into water.[4]

The author had tried in vain to change the sense of heliotropism in animals by chemical means, and this gap was felt the more keenly, inasmuch as he was led to believe that chemical changes might ultimately determine changes in the sense of heliotropism. Recently, however, the author succeeded in finding instances in which specific chemical substances were capable of transforming the sense of heliotropism in animals.

The experiments were made with a fresh water shrimp (*Gammarus pulex*), which can be obtained at any time in large quantities at Berkeley. If one puts a large number of these animals suddenly into distilled water or into common tap water, they all become at first very negatively heliotropic. It is possible that this is caused by the mechanical agitation, connected with the trans-

[1] Groom and Loeb: *Biologisches Centralblatt*, 1890, p. 160.
[2] Loeb: *Pflüger's Archiv.*, 1893, liv, p. 81.
[3] Towle: *American Journal of Physiology*, 1900, iii, p. 345.
[4] Holmes: *Ibid.*, 1901, v, p. 211.

ferral of the animals from one vessel to another, but this has not yet been ascertained with certainty. Half an hour or an hour later, the negative gathering of the animals becomes less dense, and the animals are scattered in the vessel.

These negatively heliotropic animals can be transformed instantly into positively heliotropic animals by the following substances: (1) many of the anesthetics of the fatty series; (2) many acids, except very weak ones like boric acid; (3) certain salts, like ammonium salts. Alkalis, like NaOH or Ba $(OH)_2$, and neutral salts, like NaCl or $CaCl_2$, bring about a scattering of the negatively heliotropic animals, but do not make these animals instantly and without exception positively heliotropic, as do the anesthetics or the acids.

A few quantitative data may be mentioned here by way of illustration. Ethyl acetate and similar esters instantly make all the shrimps positively heliotropic in a concentration of about $\frac{m}{500}$. Ether is effective at a higher concentration, namely, $\frac{m}{6}$. Ethyl alcohol brings about an equally rapid transformation of the negatively heliotropic animals into positively heliotropic ones in a much higher concentration, namely, $2\frac{1}{2}$ *m* solution. Paraldehyde is active at a concentration of about $\frac{m}{10}$. So far as the acids are concerned, HCl, oxalic acid and acetic acid make the animals instantly and without exception positively heliotropic in a concentration of about $\frac{m}{5000}$. In boric acid, the animals remain negative even at a concentration as high as $\frac{m}{10}$. CO_2 acts in the same way and, inasmuch as this substance is produced in the animal itself, and as the amount produced varies under certain conditions, we may now be able to account for apparently "spontaneous" changes in the heliotropic sensitiveness of these and other animals. NH_4Cl instantly makes the negatively heliotropic *Gammarus* positively heliotropic in a concentration of $\frac{m}{25}$. NH_4OH acts similarly in the same concentration. So far as neutral salts are concerned, they usually do not make the negatively heliotropic *Gammarus* positively heliotropic until the concentration is over $\frac{m}{4}$ or $\frac{m}{2}$, and even then, as a rule, no instantaneous and complete gathering of the animals at the positive side of the vessel can be produced, but only a slow and partial gathering.

Since the concentration at which the transformation of nega-

tively heliotropic *Gammarus* into a positively heliotropic animal is produced differs for different substances and inasmuch as the transformation is brought about most promptly by such substances as diffuse most rapidly into the tissues, *we must conclude that we are not dealing here with an osmotic, but with a chemical effect.*

4 (50). **"Trypanosomes and bird malaria": F. G. NOVY** and **W. J. MACNEAL.** (Presented by **GARY N. CALKINS.**)

The studies made heretofore upon the malarial parasites of birds have shown the existence of four species or types. These are:

Proteosoma.

Halteridium.

Hæmamœba majoris, Lav.

Hæmamœba Ziemanni, Lav.

In the course of an extended study of the parasites of birds, the authors encountered several new species, and, since the number is likely to be still further increased, it seemed desirable to attempt a classification. The authors based their classification largely upon the type of multiplication and the habitat of the parasite. Two genera were given; one, *Plasmodium*, characterized by formation of segmenting forms in the peripheral blood and invasion of fully developed red blood cells. The injection of blood having these parasites results in an infection. For the other genus the authors used the priority name of Kruse's, *Hæmoproteus*. This genus is characterized by an entire absence of segmentation-forms in the peripheral blood, and, with the exception of two species which form a transition as it were between the two genera, invasion of young erythroblasts is the rule. Injection of blood having these parasites does not lead to infection.

With this division, the species are arranged as follows:

A. Plasmodium, including parasites of man, some of birds, and very probably some of cold-blooded animals.

1. — *Plasmodium relictum*, syn. *Hæmamœba relicta*, Proteosoma.

2. — *Plasmodium vaughani*, n. sp.

B. Hæmoproteus, including chiefly parasites of birds, and probably offering transitional forms to the hemogregarines of cold-blooded animals.

1. — *Hæmoproteus danilewskyi*, syn. Halteridium.
2. — " *maccallumi*, n. sp.
3. — " *sacharovi*, n. sp.
4. — " *majoris*, Lav.
5. — " *ziemanni*, Lav.
6. — " *rouxii*, n. sp.

Plasmodium vaughani, n. sp., is common in robins; it resembles proteosoma, and may be easily mistaken for the latter. The hyaline body is smaller than that of proteosoma, does not displace the nucleus, contains one large pigment granule, and is readily recognizable by the presence of a large, bright, refractile, colorless globule. It segments and usually forms four cells. Canaries may be infected; apparently non-fatal.

Hæmoproteus maccallumi, n. sp., found in mourning doves. Like *halteridium*, which it resembles, it infects erythrocytes. Grows on one side, or may completely surround the nucleus. The fully developed sexual forms fill and somewhat distend the blood cells. Microgamete formation observed. The infection cannot be transferred by blood injection.

Hæmoproteus sacharovi, n. sp. This species, probably first observed by Sacharoff, who regarded it as a "leucocytozoön," is related to that of Danilewsky. Found in young mourning doves and elsewhere. Invasion begins with an infection of very young erythroblasts. As the parasite grows it pushes the nucleus to the periphery, where it is seen in the adult form on the outer edge as a cap, which is but a trifle larger than the nucleus of a red blood cell. The parasite is spherical, male and female forms common, latter predominate; blepharoplast distinct, adjoining or over the nucleus. Microgamete formation common. Infection not transferable by the blood.

Hæmoproteus majoris, Lav. This was found once by Laveran in a titmouse. This species is extremely common in robins and other birds. As with preceding species, invasion at early stage shows infection of very young erythroblasts, the small parasite lying next to the large round nucleus. As the parasite grows it pushes into the nucleus, which becomes crescentic and may almost wholly surround the parasite. The adult sexual forms are large, about 10 to 12 microns in diameter, and are readily recognizable

by the peripheral ring of the nucleus of the host cell. This cap may extend, and usually does, around two-thirds of the cell, and even more. The blepharoplast is easily seen in female cells; microgamete formation common. No infection of other birds by injection of blood swarming with these forms.

Hæmoproteus ziemanni, Lav., has been studied by Danilewsky, Ziemann, Laveran, Schaudinn, and others. Forms long spindle-shaped bodies, which are 30 to 50 microns in length. The authors have found this species, or one closely related to it, in the blood of a hawk. Sexual forms easily recognized.

Hæmoproteus rouxii, n. sp., is very common in sparrows, and represents the very earliest possible infection of young erythroblasts, so much so that it is not feasible to exclude the possibility of their being leucocytes. As the parasite grows it pushes into the nucleus, which assumes the form of a thick crescent. The parasite measures from 4 to 6 microns. Its plasma does not stain readily, and sexual forms have not as yet been recognized. Apparently always associated with this cytozoön are minute crescentic free hemogregarines. These are but 4 microns long, and are motile, crawling over the red blood cells in characteristic manner. Larger motile crescents, about 10 microns long, at times are present. Both large and small crescents are free and motile, and, it is important to note, are present in the fresh blood at the moment when drawn. They cannot, therefore, be considered as oökinetes. They are hemogregarines, and presumably constitute the extracellular stage of *H. rouxii*.

It is to be noted that the last four mentioned forms all exert pressure on the nucleus of the erythroblasts, and, as a result, give rise to very peculiar types. They are all "*leucocytozoa*" of which, thus far, there has been but one recognized type, that of *H. ziemanni*. The view of Schaudinn that the latter is a trypanosome which ingests an entire erythroblast by attaching itself to such by one end becomes untenable, inasmuch as all stages of infection from the earliest to the latest can be readily observed in the case of *H. sacharovi* and *H. majoris*. The authors regard the large spindle-shaped *H. ziemanni* as an infection of an erythroblast, and the elongated form as consequent upon an alteration of the wall of the host cell leading to increased osmotic pressure, which, acting on the poles, gives rise to the spindle-shaped forms.

In addition to the parasites mentioned, birds harbor very frequently *filaria* and *trypanosomes*. In the case of the filaria, while the peripheral blood may contain but a few, the heart blood may contain large numbers.

Trypanosomatic infection of birds is far more common than has been supposed. The largest number of infected birds seen by any one observer was eight, which were found by Dutton and Todd in Senegambia. The reason why they have not been found more commonly is because they are present in very small numbers, usually not more than one or two flagellates in a drop of blood. By microscopic and cultural methods the authors have been able to detect trypanosomes in the blood of thirty-three birds. Of this number, eighteen were detected by direct blood examination (of the eighteen birds, ten were tested culturally and gave growths); and fifteen by means of their cultivation method — that is to say, in fifteen cases where the microscope failed to show trypanosomes, the culture method showed them to be present. This shows that, as in the case of the bacteria, the cultural method is a more delicate means of detection of small numbers of parasites than is the microscope.

The occurrence of these trypanosomes with reference to the cytozoa mentioned is of special interest. Thus in thirteen of the thirty-three cases, trypanosomes were unaccompanied by any intracellular parasite, while in twenty they were associated with one or more kinds of cytozoa. It was not an uncommon thing to find multiple infections, that is, the same blood harboring, at one time, in addition to trypanosomes, two or three different species of intracellular parasites. Again, in addition to the fact that trypanosomes may be present without another parasite, is the interesting fact that when thus associated there is no constant relation between the two. In other words, the same trypanosome may be found at one time with a *proteosoma*, at another time with a *halteridium*, or with *H. sacharovi*, or with *H. majoris*, etc.

In twenty-five of the thirty-three cases mentioned, cultures were obtained. Nearly all of these have been carried through a series of subcultures or new generations. Here another important fact was brought out. The cultural method is not only the best means of detecting trypanosomes in the blood, but it is the best

means of differentiating them into species. A study of the twenty-five cultures obtained showed that they represented three, if not four, and possibly more distinct species. The cultural characteristics were extremely well marked, and offered an admirable means of differentiation. One species, more common than any of the others, was specially mentioned at this point. Its cultures present an extremely interesting appearance and are unusually luxuriant. They show two types of cells. One of these is round or in short spindles, which always occur in rosettes, with the flagella directed centrally, as in the case of *Trypanosoma lewisi*. The other type is long and very slender, almost a mere line, and is extremely motile, traveling forward and backward, with great rapidity. Very often two cells unite by their posterior ends; at times agglutinations are found and in these the whips are found situated on the outside of the mass. This long, slender type corresponds exactly to the *Spirochæte* described by Schaudinn, while the other type agrees with his *Trypanosoma*.

It is noteworthy that inoculation of the trypanosome cultures, even in large amounts, into birds failed to produce any cytozoa. In one case a canary infected with such a culture showed trypanosomes in its blood for three months without any sign of an intracellular parasite.

These facts are of importance, because of their bearing on the recent views of Schaudinn regarding the relation of trypanosomes to the intracellular parasites. As is well known, this distinguished protozoölogist believes that in the case of *halteridium* the sexual forms unite in the stomach of the mosquito to form oökinetes, which then develop into indifferent, male and female trypanosomes. This type agglutinates with the flagella directed toward the center. In the case of *H. ziemanni*, he holds that a similar change occurs in the mosquito, giving rise to long, slender spirochætes, which agglutinate with the flagella directed outward. Injections of suspensions of such infected mosquitoes produced the characteristic infection with the hemocytozoa.

It will be seen that the results obtained by the authors do not bear out Schaudinn's conclusion. The authors have shown that birds may harbor trypanosomes, even for months, without showing any intracellular parasites. On the other hand, birds rich in

such cytozoa may contain no trypanosomes. Thus, cultures attempted from twenty-six of such heavily infected birds failed to show any growth. Again, the presence of trypanosomes is not associated with any one form of intracellular parasite. Furthermore, the cultural method shows the existence of several distinct species of trypanosomes, and among these is one which presents at the same time both types described by Schaudinn as stages on the one hand for *halteridium* and on the other hand for the "leucocytozoön" of Danilewsky.

The authors therefore conclude that trypanosomes in birds may be met with as several distinct species wholly unrelated to the intracellular parasites. The greatly diverging conclusions reached by Schaudinn and the authors must be ascribed to the fact that Schaudinn worked with *mixed cultures* as developed in the body of the mosquito, whereas the authors have employed strictly *pure cultures* of these flagellates.

[The authors published the full details of a part of this investigation in the March issue (1905) of the *Journal of Infectious Diseases*. Additional papers will appear in later issues.]

5 (51). **"The gradual decrease in bacteria of the production of agglutinable substance": WILLIAM H. PARK.**

At the last meeting of the Society of American Pathologists and Bacteriologists an informal statement of this fact was made by Dr. Welch for Drs. Marshall and Knox. The experiments of Dr. Collins and the author are reported here because they were undertaken in a slightly different way and also because a certain number of confirmatory observations are of value.

The maltose-fermenting paradysentery bacillus of Flexner was grown for twenty-four hours on each of eleven consecutive days in fresh bouillon solutions of the serum from a horse immunized through oft-repeated injections of the bacillus. The serum strength in the solutions used was 1.5%, 4% and 15%. The serum agglutinated the culture before its growth in the solutions in dilutions up to 1 in 800, and was strongly bactericidal in animals. After eleven transfers the culture grown in the 15% solution ceased to be distinctly agglutinated by the serum in any dilution and ceased to absorb from the serum any appreciable amount of the agglutinins acting upon the original culture. The

cultures grown in the 1.5% and 4% solutions were changed to a less degree and agglutinated in dilutions up to 1 in 100 and 1 in 60 respectively, and continued to absorb agglutinins. The recovery of the capacity to be agglutinated was very slow in the culture grown in the strongest serum solution, when it was from time to time transplanted in fresh nutrient agar. The other cultures recovered this characteristic more rapidly.

The first culture, after growth for sixteen weeks, during which it was transplanted forty-three times, agglutinated in dilutions up to 1 in 200, and after twenty weeks in dilutions up to 1 in 400. The culture grown in 4% solution of serum agglutinated after sixteen weeks in dilutions up to 1 in 500, and one in 1.5% agglutinated in dilutions up to 1 in 800. This diminution and final almost complete lack of development of agglutinable substance in bacteria grown in a serum rich in agglutinin and immune bodies is interesting. It showed not only a rapid variation in bacteria of essential characteristics, but also indicated a possible means of adapting themselves to resist destruction in the living body, since the bacteria which ceased to produce agglutinable substance and probably, also, less substance with affinity for other antibodies, might be considered less vulnerable to these substances.

It is not certain that the agglutinin in the serum causes the change in the bacteria, for solutions may agglutinate and still not produce this effect. The fact has been noted that the horse serum of animals not immunized has much the same effect on the cultures as the immune serum. Although this suggests that the change is not due to antibodies, it does not prove this, since the serum of a horse before injections is rich in antibodies for the typhoid-colon groups, due possibly to the passage of bacteria from the intestines into the circulation.

The author's explanation of the process is that there are substances in the serum which attack certain parts of the bacteria such as the agglutinable substance. In the increase of bacteria in the serum those which produce the least of these substances are least inhibited and therefore develop most rapidly. When cultures are made from serum solution to serum solution daily, a gradual differentiation takes place until finally bacteria producing almost no agglutinable substance develop.

6 (52). **"Some Mendelian results in animal breeding": C. B. Davenport.**

The essence of Mendelism in inheritance is its alternative character. In this it is opposed to blending inheritance (as in human skin color) which had been regarded as the typical sort of inheritance. At the Carnegie Institution's Station for Experimental Evolution certain new cases of nonblending inheritance have already been found. Among sheep it appears from Dr. Alexander Graham Bell's records that the offspring of two black sheep are (probably always) black, although one or more of the grandparents were white. It looks as if black color (like albinism) might be recessive. Among canary birds it is found that of the offspring of crested and of plain headed birds, some are crested and some are not. Poultry have been studied because of the numerous characters they exhibit. When a Japanese long-tailed, clean-legged cock was crossed on a white bantam hen, the two surviving offspring were highly colored like the father and had abundant feathers on the legs like the mother.

7 (53). **"On the decomposition products of epinephrin": John J. Abel** and **R. de M. Taveau.** (Presented by **William J. Gies.**)

The empirical formula, $C_{10}H_{13}NO_3 \cdot \frac{1}{2}H_2O$, adopted by Abel for that member of the epinephrin series which he has called epinephrin hydrate (the adrenalin of Takamine) is, at present, the subject of an acute controversy. The authors have been engaged in a repetition of the analytic work on which Abel based the above formula for epinephrin hydrate. In view of the suggestion of Abderhalden and Bergell that this substance should be prepared in a way that avoids oxidation by the air, the authors have undertaken the laborious task of preparing and purifying it in an atmosphere of hydrogen. The results of their work in this direction will soon be published.

The authors emphasized the fact that the $\frac{1}{2}H_2O$ of their empirical formula has always been regarded by them to be water of constitution, and not water of crystallization as their opponents have taken for granted. The assumption that this $\frac{1}{2}H_2O$, so easily removable by high heat and by various acids, is water of constitution necessitates doubling the present empirical formula, a pro-

cedure which is at variance with the molecular weight determinations of v. Fürth and Jowett. These determinations are, however, open to serious objections, as will be shown at length elsewhere.

Work on the decomposition products of both alkaloidal epinephrin and epinephrin hydrate has been continued. The basic substance, $C_3H_4N_2O$, which is obtainable equally from both forms of epinephrin, has been decomposed by treatment with caustic potash into ammonia (NH_3), methylamin ($CH_3.NH_2$), and methylhydrazin ($CH_3.NH.NH_2$). Of these decomposition products, methylamin is also obtained from both modifications of epinephrin. Methylhydrazin has thus far not been obtained either from epinephrin or its hydrate. This degradation product is of great importance in throwing light on the chemical constitution of the new base, $C_3H_4N_2O$, for its appearance, under the circumstances referred to, proves that the two nitrogen atoms of this base are directly combined one with the other, and suggests, among other things, for this base a ring structure, such as is found in bodies of the pyrazolon $\left(\begin{matrix} N \text{———} NH \\ \| \quad\quad | \\ CH.CH_2.CO \end{matrix}\right)$ series. It may here be noted that pyrazolin carboxylic acids can easily be made to yield hydrazin.

A full discussion of the bearing of the above results on the constitution of epinephrin must be deferred until it has been determined whether the oxidation product $C_3H_4N_2O$, is of a primary or of a secondary character. In any case, an adequate constitutional formula for epinephin must be able to account for all the decomposition products that have been named.

In conclusion it may be mentioned that the authors have repeatedly obtained in their recent work small quantities of skatol on fusing epinephrin hydrate with caustic alkalis — a product which has been erroneously supposed to be obtainable only from the mono-benzoyl series of epinephrin compounds.

Ninth meeting.[1]

Professor C. A. Herter's private laboratory, at 819 Madison Avenue, New York. December 21, 1904. President Meltzer in the chair.

[1] Reprinted from *Science*, 1905, xxi, p. 105; *American Medicine*, 1905, ix, p. 72; *Medical News*, 1905, lxxxvi, p. 229.

8 (54). **"Radium and some methods for its therapeutic application,"** with demonstrations: **HUGO LIEBER.** (By invitation.)

Mr. Lieber gave an account of the discovery of radium by Mme. and Professor Curie, and demonstrated many radioactive phenomena. Special attention was drawn to recently discovered facts bearing on radium emanation. For a time it was thought that radium discharged directly (*a*) the so-called "emanations," which had practically no penetrating power and which, like a gas, were readily carried from one point to another by an air current; and (*b*) the so-called "rays" — *alpha* rays of very low penetrating power, *beta* rays of considerably greater penetrating power, and *gamma* rays of enormous penetrating power. Later investigations have shown, however, that radium discharges primarily *emanations* and *alpha rays* only. However, the emanations soon disintegrate, and the disintegration products yield the beta rays and the gamma rays. Consequently the powerful beta and gamma rays are the products of a decomposition product of radium. The proportions of the radiations given off by a certain quantity of radium and its disintegrated emanations are about 95% alpha rays and about 5% combined beta and gamma rays. Because of their nearly negative penetrative power, the alpha rays, as well as the emanations, are practically unavailable for therapeutic purposes when the radium is used in glass tubes or similar containers. Even the superficial layers of a given radium preparation are relatively impervious to both the emanations and the alpha rays proceeding from the underlying portions of the preparation. Therefore, it is essential, in order to obtain full radioactive effects, that (1) the given quantity of radium should be spread so thin that, from the practical standpoint, an upper layer would not exist and (2) should be held in a container with walls that would be permeable both by the alpha rays and by the emanations.

Aschkinass, Dantzig, Caspari, Scholtz, Pfeiffer, Friedberger, and others have shown that radium radiations exert beneficial effects upon certain diseased tissues, as in sarcoma, lupus, carcinoma, etc. Marckwald states: "The radium rays have, besides a dilating effect, an elective influence upon the cells of quickly-growing tissues, as well also as bactericidal properties, three

powers which are known to be very effective therapeutic factors." Germicidal effects of the radium rays have been shown repeatedly. Thus Scholtz lately demonstrated that even typhoid bacilli can be destroyed with radium radiations. It is not surprising, from what was stated above regarding the low penetrative power, etc., of the emanations and the alpha rays, that disappointments have frequently resulted from the therapeutic application of radium. The author believes that in all probability many such disappointments have ensued solely because the practitioner has not had available in such cases just those radiations of radium which are required for therapeutic effects. Then, too, the radioactive powers of each radium preparation should be definitely ascertained in the first place, not taken for granted.

This opinion of past therapeutic failures led the author to conduct some experiments designed to discover a method of applying radium more advantageously. Such a method seemed to require (*a*) a disposition of the radium in very thin layers, so as to yield the maximum proportions of alpha rays and emanations, and (*b*) its application in a container permeable by the rays and emanations. These experiments finally led to the production of what the author terms "radium coatings."

Radium coatings are made in the following manner: Radium is dissolved in a proper solvent and into this proper solvent a proper material is dipped. This material is then withdrawn, with radium solution adhering to it. The solvent quickly evaporates, leaving the material covered with an exceedingly thin film of radium. The kind of solvent to be used is determined by the nature of the material to be coated. Such solvents are employed as have a tendency to soften and to permeate the material which is to be coated. Thus, if *celluloid* rods, discs, or similar instruments are to receive a radium coating in order to be used for the treatment of a certain disease, solvents such as alcohol, amyl acetate, etc., may be employed. These solvents have a tendency to soften celluloid temporarily. As the solvent evaporates, the radium is very uniformly distributed over the celluloid, and is also incorporated on its surface. In order to prevent accidental removal of the radium from such coatings, the celluloid instruments produced in this way are dipped in a proper collodion solu-

tion and are promptly removed from the same. In this process the whole radium coating is covered with a very thin film of collodion. In the course of a few days this film of collodion becomes so tough that it will strongly resist destruction, even when considerable force is used, thus affording ample protection for the underlying radium. This thin film, however, permits the alpha rays as well as the emanations to penetrate freely. In the preparation of these coatings both the radium and the collodion solutions are colored with an anilin dye. This is done to show the part that has been coated. Besides, if the radium happens to be removed by accident or otherwise, as by scraping, etc., disappearance of the color from the damaged places makes such removal evident.

The great difference between radium used in containers, composed even of exceedingly thin aluminium, and radium used in the form of the coatings here described, was demonstrated. Thus, in their relative influences on the electroscope, it was seen that a delicate rod coated at its tip with radium bromid of 10,000 activity and holding, therefore, very little radium, compared very favorably in its effects with a gram of radium bromid of 10,000 activity in a *glass* tube, or with 10 mg. of radium bromid of 1,000,000 activity in a very thin *aluminium* tube.

As is well known, when we observe the effect of uncovered radium upon a zinc sulfid screen, such as is shown in the spinthariscope of Crookes, we see a large number of brilliant scintillations. It has been proved conclusively that these scintillations are produced solely by the impact of the alpha rays upon the zinc sulfid. If what has just been said is correct, that is, that the alpha rays can penetrate the collodion coating of the author's celluloid rods, discs, etc., then the latter should yield evidence of these scintillations when placed upon a zinc sulfid screen. Such scintillations were abundantly demonstrated with various forms of the coatings.

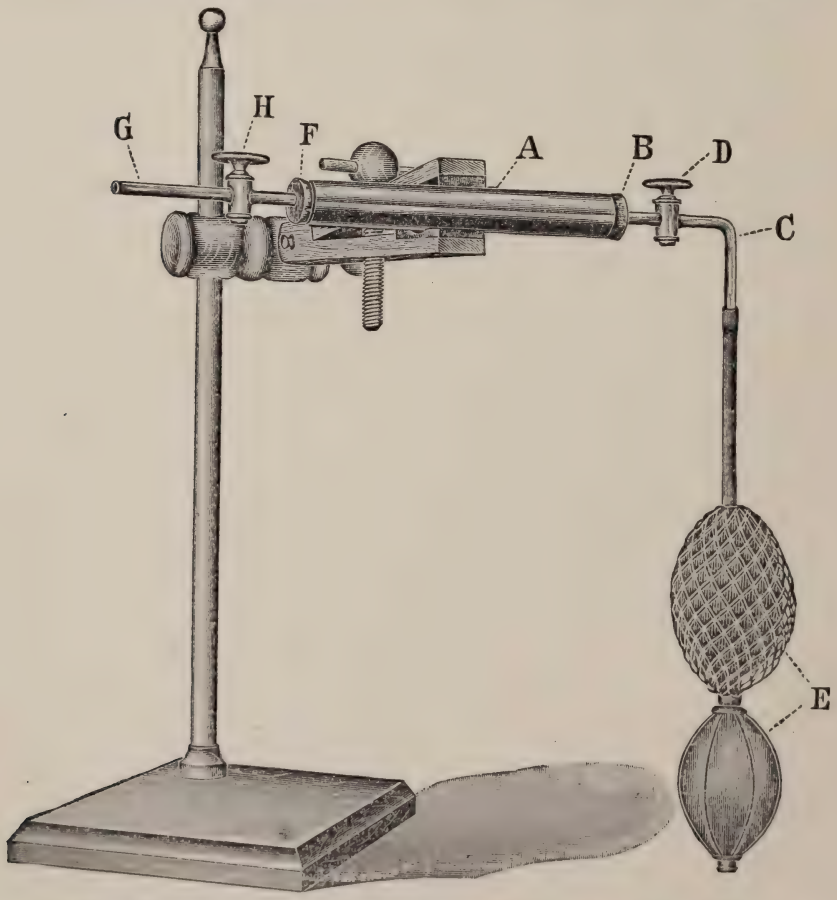
The radium coatings make it possible to apply radium directly to practically any part of the body. The radium thus applied would be practically equivalent in radioactive effects to the same amount of uncovered radium in the same thin layer. Any instrument could be conveniently coated with radium at a proper place, by the method indicated, and the radiations could be brought into action wherever desired.

As has already been stated, radium emanations will always follow the air current. Consequently, if some uncovered radium is placed in an air current, the current will carry with itself the emanations, which emanations will ionize the air and discharge the electroscope. The author demonstrated these phenomena with some strips of celluloid coated with radium and covered with collodion. The same phenomena were demonstrated with a tube which had been similarly coated with radium and collodion on the inside. When air was blown through this tube toward the electroscope, the latter was discharged instantly.

It has been stated that radium radiations destroy bacteria. Rutherford and Soddy and others have accordingly advised that radium emanations be blown into the lungs in tuberculosis. The author believes that the difficulties in the way of testing such a therapeutic application of radium are solved by the apparatus described below. (See the figure on the next page.)

The apparatus consists of a celluloid tube, A, with a complete coat of radium on the inside and a collodion covering on the radium coating. By means of a tightly fitting rubber stopper, B, a small glass tube, C, is inserted, which at its end has a large perforated bulb in order to produce a uniform air current throughout all parts of the tube. This glass tube, C, has a glass stop-cock, D, and connected with the latter is a rubber bulb, E. By means of another rubber stopper, F, a glass tube, G, with a glass stop-cock, H, is inserted into the other end of the tube. With the loose end of the last glass tube, G, any desirable apparatus may be connected by means of a narrow rubber tube, etc. If we close the two glass stop-cocks and allow them to remain closed for several hours, a considerable quantity of emanations will collect within the closed tube. If we now blow up the rubber bulb, E, and slowly open the exit stop-cock, H, and then slowly open the entrance stop-cock, D, the compressed air will enter the coated celluloid tube, A, the emanations which will have collected within the tube will follow the course of the air current, and on inhaling this air, the patient will receive the full charge of radium emanations in his lungs. A cancer of the throat or of any other part of the body may be treated by the application of a proper radium rod directly, and beside that, by blowing the emanations, if necessary, directly into the seat of a

cancer through a finely pointed hollow exit rod. It is a well-established fact that these emanations are readily deposited upon surfaces with which they come in contact, especially moist surfaces. If, therefore, we permit these emanations to slowly pass into or upon a diseased tissue, they will doubtless adhere to a considerable extent to the tissues treated in this way, especially if the applica-



tions are made under proper plasters, coverings, coatings, etc., to prevent the ready escape of the gaseous emanations. During their retention in this way, the emanations disintegrate, as was stated above.

A very great advantage of these radium coatings is that all instruments, etc., coated by the method described, can be readily

sterilized without loss of radium, for the protective coat effectually resists even continued boiling. The author demonstrated the radioactivity of a strip of celluloid which had been coated with radium and thereafter had been covered with collodion. The strip was then placed in water in a test tube and the contents vigorously boiled. Both the radium and the collodion solutions used for the preparation of the coatings had been colored with a soluble blue anilin dye. That the collodion protected the radium in this experiment was shown by the fact that the water, after boiling, was entirely free from color. The strip also retained its original radioactivity.

The availability of the radium coatings for many kinds of biological investigation is so obvious that nothing need be said here on that point. [See page 86 (150).]

9 (55). **"Some of the physical phenomena of muscle fatigue,"** with demonstration of tracings: **FREDERIC S. LEE.**

The investigation of the subject has been continued by the employment of a method by which the isotonic curves of all the contractions of an excised non-curarized muscle stimulated at regular intervals, are superimposed upon a recording surface. The differences which were previously pointed out in the mode of fatigue of the muscles of the frog, the turtle and the mammal, have been confirmed. Lohmann's work, in which a frog's gastrocnemius on being heated to a mammalian temperature, shows a course of fatigue similar to that of mammalian muscle, has been repeated and found incorrect. Both that muscle and the turtle's coracoradialis profundus, similarly heated, continue to give their characteristic curves of fatigue. [See page 60 (124).]

Kaiser's method for determining the point of the isotonic curve where the contractile stress terminates, has been employed for the frog's gastrocnemius, and it has been found that as the height of the curve diminishes in the course of fatigue, the contractile stress terminates at progressively lower and lower points. The lowering of the latter does not, however, seem to keep pace with the lowering of the summit of the curve. Hence the two points seem to approach one another.

10 (56). **"A new form of float for water or alcohol manometers,"** with demonstration: **HAVEN EMERSON.** (By invitation.)

The float consists of an aluminium cylinder with very thin wall, supporting a writing arm of fine aluminium wire. For manometer tubing of $\frac{9}{32}$ in. inside diameter, $\frac{3}{16}$ in. or $\frac{1}{4}$ in. aluminium tubing $2\frac{1}{2}$ in. long is used. This is bored out until the walls are sufficiently light. In the upper end is forced a solid cap of aluminium with a small hole in the center into which the wire for the writing lever is driven. The lower end is plugged with cork. Both ends are painted over with hot paraffin to prevent leaking. For use in alcohol a somewhat larger tube is necessary. Three crossed hairs held in place across the open arm of the manometer tube by a strip of adhesive plaster keep the writing arm centered with sufficient accuracy.

The value of the float consists in its cheapness, the ease with which it can be made, its very slight inertia, and its convenience in estimating delicate changes in pressure for which a water or alcohol manometer is needed.

11 (57). **"Gelatin as a substitute for protein in the food": J. R. MURLIN.**

In a series of experiments on dogs the starvation nitrogen was first determined during fasting periods. Varying amounts of gelatin, containing from one fourth to two thirds of this amount of nitrogen were then fed, the remaining three fourths to one third of the starvation quantity being supplied in meat or other proteins. The calorific requirement of the animal, estimated from Rubner's tables, was made up in each experiment with fats and carbohydrates. Results show an equal sparing of the body-protein, whether one fourth, one third or one half of the starvation nitrogen was fed in the form of gelatin, the coincident sparing of protein by fats and carbohydrates being the same. When the coincident sparing of protein by non-nitrogenous food was increased by feeding a larger percentage of carbohydrates and less fat, the fraction of the starvation nitrogen fed in the form of gelatin could be raised to two thirds, the other one third being fed in meat. Nitrogenous equilibrium was maintained on this diet for several days.

The same result was obtained on man. The starvation nitrogen was obtained by analysis of the urine and feces during a fasting period of three days, and equilibrium was then established at this level on a mixed diet containing two thirds of the nitrogen in meat, the other one third in cereals. Then for two days the meat nitrogen was replaced entirely by gelatin nitrogen, the other one third remaining the same, and the potential energy supplied was increased from 40 to 48 cal. per kilo of body-weight by giving more cane-sugar, which served at the same time to make the gelatin more palatable. The nitrogen equilibrium was not disturbed during these two days nor on the two following days, when the diet was exactly the same as before the gelatin period.

12 (58). **"The reductions in the body in fever,"** with demonstrations: **C. A. HERTER.**

The author called attention to the influence of temperature on the activity of reduction in the living organism as indicated by intravital infusion of methylene blue. Elevation of the body temperature greatly accelerates the rate of reduction in the tissues. This was demonstrated by means of an intravital infusion of methylene blue in a rabbit, whose body temperature had been elevated to 42° C. through the external application of heat. Simultaneously with this infusion, another infusion was made in a rabbit of approximately equal weight, in which the temperature was maintained at about 39° C. In other respects, the conditions of the infusion were as nearly alike as possible in the two animals. A definite contrast was noted at the close of the infusion between the organs of the two animals as respects their color, the normal rabbit showing more color than the one in which the temperature had been elevated. The differences in the nervous system and the muscles were particularly striking. Even during life, an inspection of the muscles indicated that the reduction was carried on with greater rapidity in the heated rabbit than in the normal one. Previous observations on the reducing action of the animal body under the influence of cold were referred to.

13 (59). **"The measurement of the reducing processes of cells in vitro,"** with demonstrations: **C. A. HERTER.**

An apparatus was demonstrated which had been devised for the purpose of measuring the reducing processes of the different

kinds of cells *in vitro*. Definite quantities of organ pulp were placed in specially constructed tubes and anærobic conditions were established by the passage of nitrous oxid gas. Definite quantities of methylene blue of known strength were then added. The rate of reduction was indicated by the disappearance of the blue color owing to the reduction of the animal cells. It was shown that *in vitro* the influence of temperature is the same as that observed in the living organism. The influence of alkali in accelerating reduction was also shown. The action of salts and various poisons is at present the subject of investigation.

14 (60). **"Some medical applications of the naphthoquinon sodium mono-sulfonate reactions,"** with demonstrations: **C. A. Herter.**

The author demonstrated a substance of singularly great powers of condensation with other organic substances, this condensation resulting in the formation of colored bodies. He demonstrated especially the reactions of naphthoquinon sodium mono-sulfonate with anilin and various amins, with nicotin, conin, piperidin, and finally with indol, skatol and pyrrol. The reactions with indol, skatol and pyrrol possess unusual physiological and chemical interest and will form the subjects of future publications.

The reaction with pyrrol occurs in the cold and is evidenced by the deepening red which on the addition of alkali changes to purple, violet, blue and finally reddish-brown. The addition of acid to the red solution obtained without alkali is followed by the development of a green and finally brown color. These color reactions (and particularly the one dependent on acids) occur with such rapidity if one uses concentrated heated solutions of pyrrol, that the characteristic color stages may be of extremely short duration. This reaction with pyrrol is a highly characteristic one, and should prove of service to chemists.

Among the biological and medical applications of the naphthoquinon sodium mono-sulfonate reactions, the author mentioned the study of various aromatic compounds in the organism, the occurrence of certain intravital syntheses, the detection in the urine of organic compounds, such as para-amidophenol, and the development of a method of staining the bile capillaries by means of intravenous infusion of the derivatives of the naphthoquinon

compound. The author also stated that these substances facilitate the study of the relation between the chemical constitution and distribution of poisons in the body.

15 (61). **"On the rate of absorption from intramuscular tissue,"** with demonstrations: **S. J. MELTZER** and **JOHN AUER.**

In physiology no distinction is made between absorption from the subcutaneous tissue and absorption from muscles. In experimental infection and immunity, injections of virulent toxic and antitoxic materials are being extensively employed, but intramuscular injection has not yet even been thought of. In therapeutics it is practised promiscuously, and for the reason, as pharmacologists and clinicians expressly state, that it gives less pain and causes less frequently the formation of abscesses.

The authors came upon the observation that absorption from the muscles is incomparably more rapid and efficient than from the subcutaneous tissue and tested the matter with several substances. With *suprarenal extract*, it was tested in three ways.

1. *By the effect upon blood-pressure.* — A subcutaneous dose of 0.6 c.c. adrenalin or less per kilo (rabbit) exerts no effect, and the variable effects of larger doses consist in a rise of pressure of from about 10 mm. to 20 mm. of mercury, which sets in late and develops slowly. An intramuscular injection of 0.5 c.c. or 0.4 c.c. per kilo, or even less, invariably causes, on the other hand, a considerable rise of pressure, which sets in after a very short latent period and reaches its maximum in a few seconds. The curve obtained after intramuscular injection is very similar to that after an intravenous injection. The increase has been as high as 50 mm. or 60 mm. of mercury and may go even higher. The course of the curve is frequently interrupted by "vagus pulses."

2. *By the effect upon the pupil on the side from which the superior cervical ganglion had been previously removed.* — An intramuscular dose of 0.5 c.c. or 0.4 c.c. of adrenalin per kilo causes dilation of the pupil in less than a minute, while such a dose given subcutaneously rarely produces any effect. The effect of a larger subcutaneous dose sets in only after 10 or 15 minutes.

3. *By prostration effects.* — A dose of 0.5 c.c. per kilo will prostrate a rabbit in a minute or two, after intramuscular injection.

In cases of subcutaneous introduction, prostration does not occur until after 20 or 30 minutes, and even then is induced only by much larger doses.

Further tests were made with *curare*. A dose can be found which will have no apparent effect after subcutaneous injection, but which, after intramuscular introduction, will cause paralysis of the voluntary muscles in a few minutes. The authors also established striking differences between the effects of the two modes of application in the cases of *morphin* and *fluorescein*.

Tenth meeting.[1]

[Second Annual Business Meeting.]

Rockefeller Institute for Medical Research. February 15, 1905. President Meltzer in the chair.

16 (62). **"Degrees of susceptibility to diptheria toxin among guinea-pigs. Transmission from parents to offspring": THEOBALD SMITH.** (Presented by **WILLIAM H. PARK.**)

The author called attention to the usefulness of the antitoxin unit furnished by the Institute for Experimental Therapy under the direction of Professor Ehrlich in the routine testing of the strength of diphtheria antitoxin. The one uncertain element is the relative resistance of the guinea-pigs to diphtheria toxin.

In the course of the past nine years the author has given considerable personal attention to this subject and found that different dealers furnished guinea-pigs of slightly different susceptibility. This difference was attributed to environment and care. The animals bred under the author's supervision generally showed maximum resistance. Irregularities in the routine tests during the past year led the author to look up the genealogy of the pigs used and he found that the different degrees of resistance belonged to certain families or litters and were constant for those families. Thus, one mother gave birth to young which did not react to what was the usual fatal dose. Four successive litters possessed the same resistance. As each pig could be tested but once the precise degree of resistance could not be measured, but it appeared prob-

[1] Reprinted from *Science*, 1905, xxi, p. 580; *American Medicine*, 1905, ix, p. 491; *Medical News*, 1905, lxxxvi, p. 666.

able that this family could stand 40% more toxin when mixed with the antitoxic unit than those of average susceptibility. Other mothers were traced whose offspring possessed less resistance than the ones described, but could still neutralize 20% more toxin when mixed with the antitoxic unit than the average.

It would seem from these observations that different degrees of susceptibility to toxin are to be found among guinea-pigs and that the special degree possessed by any one is not to be attributed to individual variation, but to a family trait or character. The resistance in the cases cited could not be attributed to any preliminary treatment with toxins and antitoxins. Experiments are now under way to determine the part played by the male in the transmission of toxin resistance. In the case of the most resistant family, the four litters were the offspring of two males.

17 (63). **"The protective action of venom upon blood-corpuscles,"** with demonstration: **HIDEYO NOGUCHI.** (Presented by **SIMON FLEXNER.**)

That concentrated solutions of venom fail to destroy and tend to preserve blood-corpuscles was noted by Mitchell and Stewart. Among the recent writers who have paid especial attention to the interpretation of this phenomenon are Kyes and Sachs. They ascribe it to deviation of the hemolytic complement through the excess of venom amboceptors. The study which forms the basis of this brief communication shows the hypothesis of Kyes and Sachs to be untenable, since it could be demonstrated that (1) the protective action fails to occur with venom in which, through heating to from 95° to 100° C., the hemolytic principle has been preserved, but certain other constituents have been coagulated, and (2) the action extends to protection of the corpuscles from laking by water, ether, saponin, etc. The conclusion which has been reached by the author is that venom unites with the globulins and especially with the hemoglobin of the red corpuscles, yielding a water-insoluble compound to which the protection is due. Various substances, such as salts, acids and alkalis, restore the hemolyzability of the corpuscles by dissolving the venom-hemoglobin compound. The permeability of the corpuscles is not markedly altered.

18 (64). **"The results of attempts to cultivate trypanosomes from frogs."** A preliminary report: **JOSEPH LEWIS** and **HERBERT U. WILLIAMS.** (Presented by **AUGUSTUS B. WADSWORTH.**)

During the year 1904 an effort was made in the pathological laboratory of the University of Buffalo to make studies on hematozoa in the lower animals. In a considerable number of normal cats, dogs, rabbits and guinea-pigs no hematozoa were found. The results of other examinations were as follows: 51 English sparrows (*Passer domesticus*), half in the winter, half in the spring, all negative; 27 mud-puppies (*Necturus maculatus*) in March, all negative; 40 toads in the summer, all negative. In 140 frogs from the Niagara river there occurred the following infections: 14 with *Trypanosoma*, 5 with *Drepanidium*, 1 with *Filaria*. *Drepanidium* was found both in the summer and fall. The infections with *Trypanosoma* were distributed as follows:

In July, of 15 frogs, 2 showed trypanosomes.

In August, of 26 frogs, 10 showed trypanosomes.

In September, of 14 frogs, 2 showed trypanosomes.

From October to December, of 85 frogs, none showed trypanosomes.

In one case *Trypanosoma* and *Drepanidium* occurred in the same blood. The trypanosomes had the usual characters of *Trypanosoma rotatorium* (*ranarum*). They were in no case numerous; two were rarely seen in one low-power field. The frogs appeared healthy. Eight attempts to inoculate normal frogs by way of the peritoneum with the blood of infected frogs gave negative results.

Attempts at cultivation. — The blood of frogs and toads was taken to make blood-agar (used by Novy and MacNeal for the cultivation of trypanosomes).[1] The blood was first examined carefully to see that it was free from parasites. The animal was etherized and placed in $HgCl_2$ solution 1 to 1,000 for 15 minutes, rinsed with distilled water, opened with all precautions, the blood from the heart taken with a sterile pipette, and mixed rapidly with the water of condensation on slanted agar tubes (made with meat extract and peptone, and slightly alkaline to litmus). Two or three drops of blood were used for each tube. The tubes were sealed with rub-

[1] See page 23 (87).

ber stoppers and allowed to stand five or ten days so that contaminations with bacteria might be detected.

1. The blood of frogs infected with *Trypanosoma rotatorium*, collected in the same manner, was mixed with that in blood-agar tubes prepared and tested as just mentioned. The tubes were kept at the temperature of the room. Cultures made from two infected frogs showed, after two weeks, growths of flagellate protozoa (both on toad's blood-agar and frog's blood-agar). The organisms were of a very long oval form, the bodies of the largest being $2\,\mu \times 18\,\mu$. There was a single flagellum, which was often nearly as long as the body. Only the largest forms showed a trace of an undulating membrane, which never approached the development of this structure in *Trypanosoma rotatorium*, and which did not appear in stained preparations. Motility was not very pronounced. Numerous small forms were seen evidently representing various developmental stages. In preparations stained according to Romanowsky, a blepharoplast (micronucleus, centrosome) was seen at the base of the flagellum and near the *anterior* end. The nucleus appeared to be represented by numerous chromatin granules in the posterior end. It may be noted that Smedly[1] found the centrosome at the anterior end in the cultural forms of the rat trypanosome. Numerous observers have seen typanosomes lacking the undulating membrane under artificial conditions.

The growth in the tubes was never luxuriant. Arrangement in rosettes was not seen. One generation only of subcultures grew. All the cultures soon died. A single attempt to inoculate a normal frog gave a negative result. These experiments were interrupted, as both the authors went out of town.

2. As is mentioned below, the blood of frogs infected with *Drepanidium* was added to blood-agar[2] tubes to see if *Drepanidium* could be made to live or undergo further development. Tubes thus inoculated, showed, in one case, trypanosomes in about ten days. For the moment it appeared as though trypanosomes had developed from *Drepanidium*. Some of the same blood-agar to which no *Drepanidium* blood had been added, was examined again and found to contain the same trypanosomes. They must,

[1] Smedley: *Journal of Hygiene*, January, 1905.

[2] Made from frog blood.

of course, have been derived from the frog from which the blood-agar was made. This frog's blood was examined for parasites before using it to make the medium and just before inoculating it, so that trypanosomes must have been present in numbers too small to show in several large cover-glass preparations, or they existed in some developmental stage not recognized. Novy and MacNeal have also secured cultures of trypanosomes from birds, where none were found by direct examination of the blood with the microscope [page 23 (87)].

In some preparations from the blood-agar tubes as many as four trypanosomes appeared in one field (Zeiss, DD., No. 3 ocular), and there can hardly be any doubt of their having multiplied. The motion of the trypanosomes was active and characteristic. They were much smaller than *Tr. rotatorium*, with rare exceptions, the body being usually about $3\,\mu \times 16\,\mu$. The flagellum was hardly half as long as the body. On the small forms the undulating membrane was not distinct, but the flagellum was plainly marked. Large forms, similar to *Tr. rotatorium*, except that the flagellum was lacking, occurred, but were rare. The nucleus and blepharoplast were placed as in *Tr. rotatorium*, as far as could be determined, but the amount of material was so small that satisfactory, stained preparations could not be secured.

With the trypanosomes there were associated spindle-shaped or crescentic bodies, about $12\,\mu$ in length, looking much like the crescents of æstivoautumnal malaria, except for lack of pigment. These bodies contained several (usually four) shining chromatin granules symmetrically placed in the middle. Motility was doubtful, and in any case slight. Flagella were not seen. The crescentic forms were probably some developmental stage. The crescentic bodies were observed for eight weeks. Motile trypanosomes were observed for five weeks. No growth occurred in subcultures. Two frogs were inoculated by way of the peritoneum from tubes containing the crescentic bodies, with negative results.

3. Attempts to produce development of *Drepanidium* were made from three frogs infected with this parasite, both on frog's and toad's blood-agar. The results were negative, although motile *Drepanidia* were discovered after ten days, and the parasites remained for weeks apparently unaltered within the blood-corpuscles.

Conclusions. — Trypanosomes from the frog may be cultivated on blood-agar, but, in the authors' experience, with considerable difficulty.

From a frog infected with *Tr. rotatorium* a flagellate organism was cultivated, showing important points of difference from *Tr. rotatorium.* It is possible that, owing to the technical difficulties of the experiment, some other organism may have found its way into the tubes. This is improbable.

Undoubted trypanosomes developed in blood-agar prepared from a frog whose blood, during life, showed no trypanosomes. They resembled *Tr. rotatorium*, but were usually much smaller. As this blood-culture medium was inoculated with blood from another source containing *Drepanidium*, it nearly led to the conclusion that *Trypanosoma* might develop from *Drepanidium.* We have here an illustration of the ease with which mistakes may occur in the cultivation of hematozoa which are suspected of passing through cycles. Such a possibility had been pointed out in advance by Novy and MacNeal before this society [page 23 (87)].

There was no evidence from the experiments to show that development of *Drepanidium* can occur on blood-agar.

It is unlikely that material with which further studies may be made can be secured before next summer (1905). As trypanosomes are now exciting so much interest, and are being so widely studied, the authors deemed it best to report their results at this time, although the work is incomplete.

19 (65). **"Experimental measles": LUDVIG HEKTOEN.** (Presented by **EUGENE L. OPIE.**)

The search for the cause of an infectious disease like measles becomes greatly simplified when we learn how to secure the unknown "virus" in relatively pure form unmixed with common microbes. Various methods may now be applied to the investigation of the virus. The transmission of measles from mother to fetus would seem to point to the presence of the cause of the disease in the blood. In the twenty cases of fetal measles collected by Ballantyne, it seemed that the infection of mother and fetus must have been simultaneous, because the eruption in both corresponded in character. In order to learn something further as to the presence

in the blood of the cause of measles, inoculations of human beings would seem to be necessary; because, so far as we now know, this disease is probably not communicable to animals. Grünbaum's experiments with measles in the chimpanzee appear to have given negative results.

Critical review of the literature shows that almost without exception the recorded experiments in the inoculation of measles, for which positive results have been claimed, are without real significance. The claims that the experiments of Home, of Wachsel, of Speranza, of Katona, of McGirr, of Bufalini gave definitely positive results do not stand close scrutiny in the light of the evidence at hand: In many instances the rubeolous nature of the sickness, sometimes very mild, following the inoculation and regarded by the experimenters as measles, is not at all securely established, and in practically all cases the possibility of natural infection was not excluded. These experiments, practically all of which were undertaken with the idea of producing a modified form of the disease, consequently permit no conclusion as to the infectiousness of the blood or other substances in measles. If we accept Mayr's results as they are given by him it may be concluded that in measles, nasal mucus and cutaneous scrapings (containing blood, epithelial débris, and tissue juices) may contain the cause of measles at or near the height of the eruption.

In the following experiments the author tried to determine whether or not in measles at the height of the attack the blood contains the cause of the disease. In these experiments special care was taken to exclude natural infection.

1. The blood injected was taken from a boy of 9, who, in the later stages of desquamation after an uncomplicated attack of scarlet fever, developed a rather mild but typical attack of measles. The first symptoms of measles appeared after he had been free from fever for about two weeks. There was headache, coryza, cough, running of the eyes, and mild febrile symptoms. Three days later a papular eruption was noted, and on the fourth day a typical rubeolous rash was present that soon began to fade, and was followed by branny desquamation.

On the fourth day 4 c.c. of blood were withdrawn from a vein at the right elbow after carefully scrubbing the skin with soap and

water, followed with alcohol. Two flasks each containing 50 c.c. of ascites broth (peptone broth 2 parts, ascitic fluid heated to 55° C. for 45 minutes 1 part) were inoculated[1] at once with 1 c.c. and 3 c.c. of blood, respectively, and placed in the incubator at 37° C. for 24 hours. At the end of this time both flasks appeared sterile, the corpuscles having settled, the supernatant fluid being clear. Subcultures made at this time upon ascites-agar, glycerin-agar, and Löffler's serum, and kept under aërobic and anaërobic conditions remained sterile; and the flask of ascites broth containing 1 c.c. of blood remained permanently sterile.

Four cubic centimeters of the mixture of 50 c.c. of ascites broth and 3 c.c. of blood, which had been kept in the incubator at 36° C. for 24 hours, were injected under the skin of the chest of a healthy medical student aged 24, just finishing desquamation after an uncomplicated attack of scarlet fever, and who readily gave his consent to the experiment. This man was not in the same hospital as the boy furnishing the blood for injection, but had been for twenty-six days in a different institution, at that time as well as before and afterward entirely free from measles.[2] So far as could be learned, and careful inquiry was made, the man injected had not had any disease at all resembling measles except scarlet fever. At no time did any local symptoms appear at the site of the injection. On the thirteenth day after injection the temperature was 101° F.; in the evening it rose to 103° F. At 9 the following morning he was given a warm bath and immediately afterward a red, papular, blotchy eruption broke out on the forehead and spread quite rapidly to the face, neck and chest. Dr. James B. Herrick, who saw him at this time, felt no hesitency in making the diagnosis of measles. By 2 o'clock an unmistakably typical full-blown, rubeolous rash was present over the greater part of the body. The temperature remained above normal for two days, when it fell to normal about the same time that the eruption began

[1] In experiments 1 and 2 a few drops of blood were allowed to run out before inoculating the ascites broth, which was done without the needle of the syringe touching the culture fluid.

[2] In both experiments the injections were made by the author. At the time the injections were made he had not seen any cases of measles within 24 hours. When in the measles ward the usual precautions were used and, of course, similar precautions were followed when visiting the subjects of the experiments — clean long gowns, caps, clean hands, etc. Freshly autoclaved syringes were used for the injections.

to fade. An uneventful recovery followed without any complications whatsoever, the desquamation being branny. There was during the entire illness freedom from respiratory symptoms of all kinds. Even during the preëruptive period there were no special local symptoms (morbilli sine catarrho). The patient's subjective condition was not much changed, if at all, at any time during his illness. The appetite continued unimpaired.

2. In this case the blood was furnished by a well-developed Irish servant girl, 21 years old, who passed through an uncomplicated attack of typical measles. About 30 hours after the earliest appearance of the rash, which still was coming out upon the extremities, 10 c.c. of blood were withdrawn from a vein at the elbow and distributed equally among 4 flasks each containing 50 c.c. of broth and 25 c.c. of ascites fluid. These flasks all remained perfectly sterile so far as bacteria demonstrable by the usual methods were concerned.

After 24 hours at 37° C., 5 c.c. of the mixture of blood in ascites broth were injected subcutaneously in the back of M., aged 28, who had not had measles so far as he knew and who gave his consent to the experiment. This patient was also recovering from a mild attack of scarlet fever, and had been at the time of inoculation for twenty-four days the sole occupant of the isolation room of a general hospital in which at that time there were no other cases of measles. There were no local changes at the site of the injection. The temperature and general condition remained normal until the evening of the eleventh day, when the temperature rose to 99.8° F., and the next day a mild conjunctivitis already suspected a day or so previously became definitely apparent. On the thirteenth day there was some cough, the tonsils were bright red, and there was an increased amount of mucous in the throat. In the afternoon the temperature, which was rising, reached 103° F. During the next night a typical rubeolous eruption came out, the first spots being noticed on the nose, and then on the forehead, face, scalp, chest, back and abdomen. The rash consisted of pink macules and papules, which disappeared readily on pressure, being largest and brightest red over the face. The forehead was quite uniformly red. The patient was not seriously ill ; there was some loss of appetite, but he slept well during the night, having been somewhat restless the preceding night. Recovery was prompt.

Cultures of the blood on the thirteenth day (1 c.c. of blood in each of three flasks each containing 50 c.c. of broth and 25 c.c. of ascites fluid) remained permanently sterile.

Conclusions. — The results of these two experiments permit the conclusion that the virus of measles is present in the blood of patients with typical measles some time at least during the first thirty hours of the eruption; furthermore, that the virus retains its virulence for at least twenty-four hours when such blood is inoculated into ascites broth and kept at 37° C. This demonstration shows that it is not difficult to obtain the virus of measles unmixed with other microbes and in such form that it may be studied by various methods.

20 (66). **"The formation of the centrosome in enucleated egg-fragments": NAOHIDÉ YATSU.**

To test whether the centrosome is a permanent cell organ or not, Professor E. B. Wilson (1901) made an experiment on the sea urchin egg by treating, with a salt solution, enucleated egg fragments obtained by shaking. He observed that asters containing centriole and capable of division were produced in the enucleated fragments. He, therefore, came to the conclusion that at least some of the centrioles in the asters thus formed must have arisen *de novo.* Some writers criticized his results, saying that the formation of the centrioles in the enucleated fragments observed by him might have been due to the shaking-out of the nuclear fluid into the cytoplasm. Wilson, therefore, suggested that his experiment be carried out by the author in a somewhat different manner — instead of shaking, to cut eggs singly and to treat the nucleated and enucleated pieces separately. The author tried this experiment on the egg of *Cerebratulus* in the summers of 1903 and 1904. Strict precautions were taken to prevent accidental fertilization, everything used for the experiment being sterilized. Individual eggs were cut into nucleated fragments (*i. e.*, fragments containing the first maturation mitotic figure) and also enucleated fragments. The latter were kept for an hour in a solution of calcium chlorid. Then they were transferred to sterilized sea water. Asters were produced in almost all enucleated fragments thus treated. What is more striking, all the asters had centrioles which were identical with those found in the whole eggs subjected to the same treat-

ment. The nucleated half was stained and was shown to have had the mitotic figure intact. From these experiments no other conclusion can be drawn than that the centrosomes, with centrioles of the enucleated fragments, were formed *de novo*.

21 (67). **"Structure of vaccine bodies in isolated cells,"** with demonstrations: **JAMES EWING.**

One of the few points on which all observers of vaccine bodies are agreed is that these structures are extremely susceptible to artificial changes. The author has for some years endeavored to find a method of examination of these bodies by which artificial changes could be avoided; and this object seems to have been accomplished by the very simple procedure of making Klatsch preparations of corneal vaccine ulcers.

A glass slide is cleaned with soap and water, and thoroughly heated in a Bunsen flame. It is then found to be unusually adhesive. The cornea of an anesthetized rat or rabbit, presenting a vaccine ulcer at any stage, is exposed by holding back the eyelids and protruding the eyeball. The cooled slide is then lightly applied to the ulcer and quickly withdrawn without lateral motion. The slide carries away with it an impression of the ulcer in the form of isolated cells or groups of cells loosened by edema. In this way ten to twenty impressions may be taken in serial order and the minute ulcer may be completely excavated without sacrificing the animal. The isolated cells dry instantly and may be fixed by gentle heat, and afterward by methyl alcohol, and then stained by various methods, preferably by Nocht-Romanowsky for ten minutes. The vaccine bodies are then presented with a clearness equal to that of the malarial parasite in blood spreads.

In the Klatsch preparations stained by Nocht's method the following features of the vaccine bodies appear to be demonstrated. The vaccine body is a portion of the cytoreticulum, its reticular structure being continuous on the one hand with the cytoreticulum and on the other usually with the nuclear reticulum. The clear zone surrounding the vaccine body in sections of tissue is an artifact. The reticulum of the vaccine body takes the chromatin stain, indicating that it contains chromatin, and many of the bodies are so intimately connected with the nucleus, the meshes of one passing

insensibly into the other, as to force the conclusion that these particular bodies have arisen by recent extrusion of nuclear chromatin into the cytoreticulum. Other bodies are disconnected from the nucleus and these may have arisen partly from the chromatin of the cytoplasm, a possibility which is furnished by Hertwig's theory of the constitution of cell protoplasm. Many of the vaccine bodies closely resemble the chromidial substance described by Hertwig in some lower animal cells. In the meshes of the reticulum the author has been unable to demonstrate any organized structure, but the meshes sometimes present nodal points of an underlying reticulum. In the fresh condition the meshes contain homogeneous refractive globules which disappear on drying.

Two series of changes may be followed in the vaccine bodies in Klatsch preparations. Many of them develop basic staining areas with loss of the central reticulum, and this process may continue until the entire body is transformed into a homogeneous globule resembling mucous or colloid. In others, the reticulum breaks up into granules, with or without the development of a central basophile mass.

The author has been unable at any stage, or in any derivative of the vaccine body, to detect the slightest definite trace of a protozoön. Yet there are several hypotheses on which it may be claimed that this cytoplasmic and nuclear material harbors an organized virus of vaccinia: (1) The meshes of the reticulum may contain a submicroscopic organism, or one which disappears on drying; (2) the vaccine body may represent a fusion of the protoplasm of the host cell with that of the parasite, forming a mycoplasm, as is claimed to exist in some diseases of plants (wheat rust); (3) some other method of fixation and staining of isolated cells may succeed in demonstrating in the meshes of the vaccine body an organized structure. In any event, it must be claimed that if the vaccine body contains a parasite, it is one quite different from any recognized type of protozoön, or from any interpretation which has yet been placed upon the structure of vaccine bodies in sections of tissue.

Besides vaccine bodies, there are other structures resembling protozoa to be seen in Klatsch preparations. One of these is ½ to 1½ μ in diameter, ring-shaped and containing a chromatin granule.

Myriads of these bodies are sometimes visible on the flat corneal cells. They appear to be peculiar cell granules, and are present in normal animals.

22 (68). "**On the tetanic element in bile,**" with demonstrations: **S. J. Meltzer** and **William Salant.**

The toxic effects of bile are manifold, and have been the subject of numerous investigations. The authors referred only to the general effects: coma and convulsions. Of the early investigators of the effects of injection of bile into animals, some observed only coma, others convulsions, and still others stated that they observed both. The last work on this subject, the work which is now frequently quoted, was done by Rywosch about fourteen years ago. Rywosch claims that coma is the only effect of the two which the injection of bile or bile salts produces.

In their extensive series of experiments on frogs the authors established the fact that the injection of bile can produce coma as well as tetanus. Coma is the frequent and the more reliable result. By a certain device, however, they were able to demonstrate the presence of the tetanic element even in bile which infallibly produced coma; it was by the addition of a subminimum dose of strychnin. A frog of medium size will not respond, even with the slightest hyperesthesia, to an injection of a hundredth of a milligram of strychnin. When such a small dose, however, is injected into a frog which has received a certain quantity of bile, the animal reacts, sooner or later, with a distinct tetanus. The effective dose of bile varies with the animal from which it is obtained. For instance, of ox bile hardly more than 0.3 c.c. need be used, otherwise the coma will completely mask the tetanic element. Rabbit's bile, on the other hand, may be given sometimes even in doses of 2 c.c. or 3 c.c., without supressing any of the tetanic features. The setting in of complete coma usually masks the tetanic element, as already stated. A close observation, however, will reveal in many cases some distinct differences between the coma of animals which received a subminimum dose of strychnin and that of animals which had not received any strychnin.

The bile of rabbits, which thus far has been more extensively studied than that of other animals, produced in many instances

distinctly convulsive effects, even without the addition of strychnin. From an analysis of their observations to the present time, the authors feel justified in making the following statements: The toxic effect of bile from normal rabbits shows an individual variation; the effect of the bile from some animals is predominantly coma, and from others tetanus. Heating the bile seems to reduce the stupefying, paralyzing effect, and to favor the appearance of the tetanic element. In the bile of nephrectomized rabbits the tetanic element was distinctly more pronounced than in the bile of normal rabbits.

The bearing which these observations might have upon the understanding of the complex symptoms of cholemia and uremia was not discussed.

23 (69). **"A preliminary communication on the pharmacology of thorium": E. D. BROWN** and **TORALD SOLLMANN.** (Presented by **WILLIAM J. GIES.**)

Thorium nitrate precipitates proteins and is intensely astringent. Its intravenous injection is promptly fatal by embolism. Applied subcutaneously, it causes local necrosis. Administered by the stomach, even large doses have no appreciable effect.

Solutions in sodium citrate were found to be nonprecipitant and nonastringent. As much as 1 gm. of thorium nitrate, per kilogram of dog, injected subcutaneously and intravenously in citrate solution, had little acute action; however, the animals appeared depressed and became emaciated. The postmortem examination, made after several weeks, showed extensive and widespread calcification of tissues. Thorium could not be demonstrated in the calcified areas.

A method for the quantitative estimation of thorium was elaborated; this gave satisfactory results with urine, to which known quantities were added. But in actual experiments on animals it was found inaccurate, a large proportion of the injected thorium escaping detection. However, it was found that on intravenous or subcutaneous injection, the thorium appeared in the urine, and not in the feces. When administered by mouth, it appeared in the feces, but not in the urine. The conclusion appears justified that absorbed thorium is excreted by the kidneys, but that the metal is neither absorbed nor excreted through the intestine.

24 (70). **"A preliminary study of the toxicological action of thorium": Arthur F. Chace and William J. Gies.**

Our experiments comprised the third series in a study, still in progress, of the toxicology of rare elements.[1] They were twenty-seven in number, and were performed on as many animals (frogs, mice, dogs). They were carried out before Baskerville's announcement of his discovery that thorium contains *two* new elements, named by him *berzelium* and *carolinium*. Publication of our results was deferred because of our desire and intention to complete the work with a study of the toxicological effects of these two new elements, which Professor Baskerville has generously agreed to furnish at a later stage in his investigations. The foregoing communication by Professor Sollmann has induced us, however, to present our results as they stand.

In some of the early experiments (1900) it was found that thorium (nitrate) had a uniform precipitative effect on various connective tissue mucoids. In a study with Professor Loeb (1902), on the antitoxic influence of ions, thorium (nitrate) was used as a tetravalent element, and was found to exert only very slight, almost inappreciable antitoxic effects in $\frac{5}{8}m$NaCl, with fertilized Fundulus eggs as the indicators. At that time we observed a strong precipitative effect of thorium on protoplasm, and a marked toxicity on various fishes, and on both fertilized and unfertilized Fundulus eggs in sea water, although these facts were not recorded in our paper.

In the experiments on frogs and warm-blooded animals the tetrachlorid was used exclusively. Of our results the following were in harmony with those reported by Brown and Sollmann: Thorium exerts marked astringent action. The chlorid is acid in reaction (in water). The aqueous solution of the chlorid blanched and hardened tissues, proteins were precipitated by it, and blood not only precipitated but blackened. Injected directly into the circulation even very small doses caused intravenous precipitation, and resulted fatally. Subcutaneous injection resulted in local necrosis. We have had no experiments with thorium in citrate solution nor on the excretion of thorium.

[1] We have already reported our observations on the toxicology of tellurium (1900) and of selenium (1902). Effects of radium are indicated on page 86 (150).

The following results extend the observations reported by Brown and Sollmann :

1. In *frogs* weighing about 25 gm. no effect was observed after introduction per os, when less than 40 mg. was introduced. This amount caused only slight symptoms. Subcutaneous injection of 40 mg. caused death in about 60 hours. Injection of the same amount per rectum appeared to be more quickly followed by toxic results than when introduction occurred through either of the former channels. Introduction per os caused irritation of the throat, increased gastric secretion, ejection of gastric contents and increased peristalsis. It required per os approximately 1.5 gm. per kilo to produce general toxic results, among which were anhydrosis, twitching, and progressive weakening of the muscles, with paralysis of the forelegs preceding paralysis of the hind ones. In fatal cases the reflexes were abolished in the usual order. The general toxic effects after introduction subcutaneously or per rectum were about the same as those following introduction by way of the stomach.

2. *In warm-blooded animals* (mice and dogs) relatively large doses administered subcutaneously caused restlessness, twitching of the muscles, progressive paralysis, labored breathing, stupor, death. Paralysis of fore-legs preceded loss of power in the hind legs. Injection of 5 gm. of the chlorid into a dog weighing 15 kilos failed to cause death. Ingestion of 2 gm. with 100 gm. of meat, by a dog weighing 6 kilos, was followed in two hours by vomiting. The ejected matter was gradually eaten during the next few hours with no other apparent effect thereafter than loss of appetite and increased desire for water.

3. The most constant and pronounced general effect of the tetrachlorid of thorium was a progressive weakening of all the voluntary muscles.

Eleventh meeting.[1]

Zoölogical Laboratory of Columbia University. April 19, 1905. President Wilson in the chair.

25 (71). **"The relation between normal and abnormal development of the frog's egg": T. H. MORGAN.**

The method of development of the frog's egg may be changed

[1] Reprinted from *Science*, 1905, xxi, p. 741 ; *American Medicine*, 1905, ix, p. 744 ; *Medical News*, 1905, lxxxvii, p. 87.

by a number of external agents. If the eggs are revolved at the rate of 180 revolutions per minute; if they are put into salt solutions of definite strengths; if they are subjected to a low or to a high temperature; if they are deprived of sufficient oxygen or surrounded by carbon dioxid in solution; if they are placed on wet filter paper instead of developing under water — in any of these ways abnormal embryos result.

An examination of the effects of these external agents brings out two points of especial interest. First, that the effects are not gradual, *i. e.*, corresponding in degree to the increasing strength of the agent employed, but that no effects appear up to a certain point and then suddenly the agent begins to act. Increasing the strength of the agent above this point may for a small range increase the effect, but this occurs within extraordinarily narrow limits compared with the lower range of non-action. The most plausible explanation of this mode of behavior in most of the cases is as follows: The agents act by coagulating certain parts of the egg, thereby preventing their further development. Other parts of the eggs that are made up of different colloids or of different concentrations of colloids remain unaffected, and proceed to carry out their development as far as the presence of the injured region allows.

The second point was the one that the author spoke of especially. Despite the great diversity in the form of the abnormal embryos, most of them may be reduced to modifications of the same type. For example, in many cases the dark cells of the upper hemisphere do not grow down over the lower hemisphere to produce there the embryo, but, remaining at the top of the egg, partially constrict off from the yolk cells at, or even above, the equator of the egg. Out of these dark cells the abnormal embryo develops usually in the form of a ring. Sometimes one side only of the ring develops and a half embryo appears; sometimes only the anterior end of the ring develops and an anterior embryo appears (often more or less "open"), etc.

The author called especial attention to the fact that the abnormal embryo develops in the material of the upper hemisphere; while the normal embryo develops over the lower hemisphere. Two interpretations of this difference seem possible. Either the

material is totipotent and an embryo may develop anywhere in the egg, appearing in the less injured regions; or the material for normal and abnormal development is the same and becomes carried downward, during the early stage of normal development, from the upper into the lower hemisphere.

The author tested these alternatives in two ways. In the first place he removed with a needle the two anterior, or the two posterior, or even all four of the upper blastomeres at the eight cell stage. The results showed that when the two upper anterior blastomeres are removed, the head end of the embryo is defective; when the two upper posterior blastomeres are removed, the posterior end sometimes shows defects. When all four of the upper blastomeres are removed, no embryo develops, although the blastoporic rim may appear near the equator of the egg, the gastrulation process may begin, and the differentiation of the germ layers takes place to a certain extent.

The author concludes from these results that some at least of the material that goes to form the embryo, lies at first high up in the upper hemisphere of the egg. In the light of this conclusion, it became necessary to examine once more the early development, especially the pregastrula stages; for despite the fact that the frog has been a classic object of study with embryologists for over a hundred years, no one has suspected that the embryo-forming material lies in the upper hemisphere and is transported to the lower hemisphere *before* the lips of the blastopore have appeared.

Briefly, the author's examination showed that throughout the early period of segmentation the material of the upper hemisphere gets pushed far out to the sides of the egg. This is brought about largely by the development of the enormous segmentation cavity. During the later cleavage period, the yolk cells of the lower hemisphere push upward into the segmentation cavity, almost obliterating it. This upward movement of the cells in the interior is compensated for by the moving downward below the equator of the outer layers of the egg. In this way the embryo-forming material is carried into the lower hemisphere. Along its edge the lips of the blastopore develop. The dorsal, lateral and ventral lips roll over the yolk (or more accurately, the yolks draw in beneath their advancing lips), and the dorsal organs of the embryo

(the embryo in a narrower sense), appear over the lower, or yolk hemisphere of the egg.

26 (72). **"Rejuvenescence in protozoa": Gary N. Calkins.**

The process of conjugation in protozoa involves either temporary or permanent union of two individuals. During this union there is a fusion of nuclear material from both organisms resulting in the formation of new cleavage nuclei in each exconjugant. The process is directly comparable with fertilization of an egg by a spermatozoön, and the biological significance of the phenomena involved is probably identical in all living things.

Since 1876 it has been generally assumed that one effect of conjugation is rejuvenescence or renewal of vitality in both of the exconjugants. This assumption has never been submitted to experimental proof. In his *Paramecium* work, begun in 1901, the author almost had the proof, but allowed the opportunity for obtaining it to slip through his fingers without realizing its importance at the time. The author's object in bringing this up at the present time is to announce that on the last day of February (1905) he started a new series of experiments with *Paramecium*, consisting of three different lines at present in about the fortieth generation after conjugation, mainly for the purpose of completing his earlier work.

Another point of general biological importance will also be investigated. In his original experiments the author found strong evidence that the old view that both exconjugants are rejuvenated is erroneous. In twenty pairs which were cultivated after separating from conjugation, one individual of each pair invariably outlived the other, thus indicating an incipient fertilization like that in metazoa. This phenomenon will be given careful study in the experiments now under way.

27 (73). **"Temperature and muscle fatigue": Frederic S. Lee.**

It has been pointed out previously by the author and others that the contraction process of the muscles of cold-blooded animals in the course of fatigue becomes greatly slowed, while those of warm-blooded animals show no such phenomenon. Lohmann has recently claimed that a cold-blooded muscle on being heated

to a mammalian temperature shows a course of fatigue similar to that of mammalian muscle, and on the other hand, that a warm-blooded muscle on being cooled, fatigues like the muscles of cold-blooded animals at a similar temperature. From the supposed effects he concludes that in the matter of fatigue there is no real physiological difference between the two groups of muscle.

The author has investigated the question by very careful methods in a considerable variety of animals, and has not been able to confirm Lohmann's conclusions. The muscles of the frog and the turtle show their characteristic method of fatigue whatever the temperature. The muscles of warm-blooded animals on being cooled and then fatigued, show either no slowing of the contraction process or only a slight slowing. The latter seems to be most pronounced in the rodents, namely, the rabbit, the mouse and the rat. [See page 37 (101).]

28 (74). **"On intraureteral pressure and its relation to the peristaltic movements of the ureter,"** with demonstrations: **DANIEL R. LUCAS.** (By invitation.)

By means of a cannula placed in the ureter and retained without ligatures, and which did not materially interfere with the peristalsis of the ureter, the intraureteral pressure and its relation to the peristaltic movements of the ureter were ascertained.

In nine experiments on dogs narcotized with morphin and atropin, the pressure in the ureter arose only to a minute degree, the average being a negative pressure, more pronounced under the influence of diuretics. In five, in which chloroform was used, the pressure was always positive; the irritability and contractility of the ureter were noticeably diminished. In six, under ether, the ureter was noted to be irritable and contractile three hours after the anesthesia was commenced; the pressure was low. In four, in which ether followed the administration of chloroform, ether showed a stimulating effect on the peristalsis, running the pressure rapidly down. In three, in which morphin and atropin, chloroform, and ether were successively tried during the same experiment, the specific effect of each as above noted was again observed. In an animal in which anesthesia was produced by decerebration, irritability and contractility of the ureter muscle were noted; the pressure was low, tending to negative on stimulating the ureter distal

to the cannula. In one animal, anesthetized with cocain by the lumbar puncture method, the same results as with morphin were obtained. In two artificially constructed systems, which were demonstrated, phenomena analogous to those observed in the animals were produced and the causes indicated.

The experiments, which also were demonstrated in part, seem to justify the following deductions:

1. A suction normally follows the peristaltic wave of the ureter; at the same time a force is exerted on the fluid in front of the wave.

2. When the ureter is normally acting, the pressure in the pelvis of the kidney remains very low, fluctuating about a neutral point, this condition obtaining through the anatomical arrangement of the pelvis, which prevents it from collapsing under negative pressure. The rhythmic movements of the pelvis of the ureter effect a milking of the portion of the pyramid which projects into it.

3. Under the influence of chloroform, or conditions which retard muscular tone and activity, the pressure in the ureter becomes greater than that prevailing in the bladder.

4. It seems obvious, then, that the ureter functions as an active agent in the formation of urine. Sollmann has shown in his perfusion experiments on excised kidneys that the formation of urine is largely, though of course, by no means wholly a filtration process.

5. Ether anesthesia does not cause a cessation of the peristaltic movements of the ureter, but because of its suppressing action on the urinary secretion the curves were not recorded.

6. The ureter remains rhythmically contractile when excised and placed in warm physiological salt solution, or for some time after the death of the animal when left *in situ*. Therefore contractility is not dependent on pressure.

7. An increased flow of urine calls forth a more efficient peristalsis, and therefore does not result in an increased pressure.

8. The force of the peristaltic wave was seen to raise a column of water of considerable height.

9. When sufficient force is exerted by the intrinsic pressure to overcome the peristaltic contractions the urine is forced back into the uriniferous tubules and accurate communication is attained

with the vascular supply of the kidney. Consequently, the blood-pressure conditions can be accurately transmitted to a recording instrument. The question then arises, why use an oncometer to obtain records of blood-pressure conditions in the kidney?

10. May not the diuretic effect, which is noted after administration of small doses of such drugs as mercury,[1] for example, be attributed, in part at least, to the increased peristalsis of the ureter, causing, as it does, an increased negative pressure and therefore an increased filtration?

29 (75). **"Further observations upon the phosphorized fats in extracts of the kidney": EDWARD K. DUNHAM.** (Presented by **PHŒBUS A. LEVENE.**)

Last winter, at a meeting of this society (Proceedings, Vol. I, page 39), the author reported observations showing that extracts from dried kidneys, obtained with the Rosenfeld alcohol-chloroform method, contained from a third to two-thirds of their weights of lecithins. Rubow,[2] of Copenhagen, reported similar results of more extended studies, printed in Danish some months earlier.

During the last few months the author has learned that it is not necessary to boil with absolute alcohol and extract with chloroform in order to obtain the large quantities of extract yielded by the Rosenfeld method. Repeated extraction of the fresh, undried organ, with 85% alcohol at 45° C., will accomplish practically the same result. When making these extracts, it was found that upon cooling, the alcoholic solutions yielded a precipitate from which a substance resembling the protagon of Liebreich could be obtained. It is to this substance that the author directs attention in this report. The yield is from about 0.14% to 0.20% of the fresh organ, or from about 0.6% to 1.0% of the dried kidney.

In order to obtain sufficient material for analysis, the author employed the method used by Cramer[3] in preparing protagon from the brain. The method employed was, in brief, as follows: The minced kidney, freed from obvious fat, was treated twice with 5% sodium sulfate solution at 85° C. to 90° C.; the filtrates were discarded and the coagulum extracted, first with 95% alcohol and

[1] Cushny: A textbook of pharmacology and therapeutics, 1901, p. 623.

[2] Rubow: Archiv für experimentelle Pathologie und Pharmacologie, 1904, lii, p. 173.

[3] Cramer: *Journal of Physiology*, 1904, xxxi, p. 31.

then repeatedly with 85% alcohol, at the boiling points, and the extracts filtered from the coagulum on a hot-water funnel. The filtrates were cooled to from 0° C. to — 5° C., the precipitate was filtered out and purified by boiling with absolute alcohol, diluting the filtrate with water to make 85% alcohol, chilling, filtering, treating the precipitate repeatedly with cold ether to remove cholesterin, dissolving in hot chloroform, reprecipitating by chilling, filtering and expressing all possible traces of chloroform. The resulting product is a white, somewhat crystalline substance, freely soluble in warm 85% alcohol or chloroform, but reprecipitating upon cooling. It contains fatty acids, phosphorus, methyl, sulfur, and, upon cleavage with dilute sulfuric or hydrochloric acid, yields a reducing substance from which an osazone may be prepared.

For purposes of comparison, a similar substance was prepared from beef brains, with the same method. Analyses of these products, two from different lots of beef kidneys and one from beef brains, were kindly made for the author by Dr. Phœbus A. Levene, with the following percentage results:

	From Beef Kidney.		From Beef Brain.	Cramer's Figures for Protagon from Beef Brain.
	(1)	(2)		
C	65.61	65.55	65.76	66.25–66.42
H	11.00	11.09	10.66	10.82–11.07
N	3.17–3.15	3.24–3.26	2.51	2.29
P	2.06	2.19	0.97	1.04
S	0.82		1.33	0.71

The substance from the kidney contains distinctly more nitrogen and phosphorus than that from the brain, and that obtained by the author from the brain contained considerably more sulfur than that prepared from the same source by Cramer. The cleavage products, however, show that all of these substances belong in the same group. The nature of the glucosid which may be obtained from these substances can only be determined by using larger quantities than have as yet been obtained, and the author hopes to report results in this direction in the near future.

30 (76). **"Comparative physiological action of salts of neodymium, præseodymium and lanthanum": B. J. Dryfuss** and **C. G. L. Wolf.**

The experiments were undertaken to investigate the compara-

tive physiological action of three elements, which are of equal valency and of approximately the same molecular weight, and whose chemical properties are closely related. The experiments were carried out *in vitro* and on unicellular organisms, bacteria and infusoria, frogs, pigeons, rats and guinea-pigs. The solutions used were the chlorids, isotonic with 0.6% sodium chlorid. In one case the propionate was used without any marked difference in the result being observed.

The chlorids coagulate egg and serum albumins, but neither the purified albumoses from Witte's peptone nor peptone are precipitated.

Dilute solutions delay the growth of bacteria and eventually kill. The solutions are not very toxic to spores. Opalina, paramecia, and vorticellæ are killed quickly, equivalent solutions of the chlorids acting in the following order of strength: Neodymium, præseodymium and lanthanum.

In frogs voluntary and involuntary muscle are quickly put out of action. This is particularly the case with perfused muscle. The solutions act in the same order as with unicellular organisms. Intravenous injection causes almost instant death, due to multiple embolism.

Attempted chronic poisoning was unsatisfactory. The solutions were introduced both subcutaneously and intraperitoneally. Some of the animals died with ill-defined symptoms. Others remained well, except for areas of induration at the seat of injection. Experiments with oral administration and on elimination will be conducted.

As all the solutions, owing to hydrolysis, are acid in reaction, the authors are inclined to attribute a large share of the acute effects to the acid present. The salts range themselves in their toxicity according to their molecular weights.

31 (77). **"The influence of bile upon blood-pressure": S. J. MELTZER** and **WILLIAM SALANT.**

There have not been very many studies regarding the influence of bile upon blood-pressure, and among these the statements are conflicting. Thus, Traube, who was the first to study it upon the kymograph, states that the intravenous injection of bile salts causes

a considerable fall of the blood-pressure, while Edmunds states, in a recent report from Halliburton's laboratory, that the effect is an insignificant one.

Nearly all of the investigators of this question within the last fifty years have employed bile salts in their experiments. The results of the authors' experiments were derived from intravenous injections of filtered ox bile into rabbits. Of the several reasons for employing bile and not its salts, one should be mentioned: It is the belief of the authors that for biological phenomena we have as yet no right to assume that the sum of the known parts is equal to the whole.

In these experiments all degrees of effects have been observed, from an insignificant one to a considerable and even a fatal fall of blood-pressure. But these different degrees could be produced at will. Besides the quantity and the concentration of the bile, it was found that the rate at which it is introduced into the circulation is the most effective factor in the result. A quantity of bile of a given concentration, which, when injected slowly, would cause only an insignificant depression, brought about a tremendous fall of the blood-pressure when injected rapidly. By injecting normal salt solution speedily the fact has been established that neither the mechanical influence of the rate of injection nor the temperature of the injected fluid can have anything to do with the pronounced effect which is invariably produced by the rapid injection of bile. Although the speed of introduction was known to be a factor in the results produced by injections of other substances, it was never taken into consideration in the studies of the effects of bile. Thus, there are also conflicting statements regarding the immediately fatal effect of intravenous injections of bile. These contradictions find their satisfactory explanation in variations in the rate of injection employed in different experiments. Thus, a quantity of bile which, when injected slowly would produce hardly any symptom, causes death within two minutes if injected rapidly.

As to the cause of the fall in pressure, or of the fatal outcome, it is generally assumed that it is due to the effect of the bile upon the heart, although opinions differ as to whether it is the heart muscle or the heart ganglia which present the points of attack. As to the manner of the injury, Traube, Leyden and other investi-

gators are of the opinion that it is caused by malnutrition of the heart, due to the hemolytic effect of the bile. This is *a priori* improbable, since the fall of blood-pressure sets in immediately at the beginning of the injection and the return to normal begins as soon as the injection is stopped. The authors have, however, disproved this theory by direct experiment. On quickly injecting bile, the blood-pressure fell rapidly and the animal died in less than two minutes. The blood which was obtained immediately from the right ventricle did not show a trace of hemolysis.

Autopsies of rabbits killed rapidly in the above-mentioned manner showed in most cases nothing but dilated flabby hearts. The failure of the heart can be caused either by the bile affecting anatomically the heart muscle or the ganglia, or by a functional process — by inhibiting the heart's action. It is known that bile produces structural changes in muscles, and in nerve fibers and nerve cells. But it is hardly conceivable that the structural changes could be induced so speedily and it is still less conceivable that structural restitution would occur with such rapidity as has been observed to take place in the return of the blood-pressure. It is therefore more probable that the bile exerts an inhibitory effect upon the heart.

In this connection the following experiments are of interest: (1) The inhibitory effects of a stimulation of the peripheral end of the vagus not only did not diminish during an effective injection of bile, but in a few instances were distinctly improved. (2) The inhibitory effect of the vagus was manifestly unimpaired shortly before the death of the animal, when the blood-pressure was not more than a few millimeters of mercury and the heart-beats were scarcely perceptible.

32 (78). **"A report of feeding and injection experiments on dogs after the establishment of the Eck fistula": P. B. HAWK.** (Presented by **ALFRED N. RICHARDS.**)

The fistulous opening between the portal vein and the inferior vena cava was made in six dogs by Dr. J. E. Sweet. Observations were made as to the behavior of the animals when fed on a diet of proteid food. One typical experiment may be summarized as follows: During eleven days on a mixed diet there were no abnormal symptoms. On the four succeeding days beef meal and milk

were fed, with the result that on the fourth day pronounced ataxia, loss of sight and hearing, complete anesthesia, and catalepsy were observed, recovery occurring on the next day. After fasting for 24 hours the animal was placed on a diet of fresh lean beef. In five days a recurrence of the above symptoms was noted. The death of the animal occurred on the fifty-ninth day of the experiment, after the dog had undergone a loss of 42% of his weight. Autopsy showed a fistulous opening 2 cm. in length and no collateral circulation. In other cases the symptoms described occurred only after the addition of Liebig's extract to the meat diet.

The administration to normal dogs of sodium carbamate either by mouth or by intravenous injection, gave rise to none of the symptoms observed by Pawlow and associates.

33 (79). **"On chemical fertilization": Jacques Loeb.** (Presented by **William J. Gies.**)

1. In two previous publications the author mentioned the fact that by applying two different methods of treatment to the unfertilized egg of the sea urchin, this egg could be caused to develop in a way which resembled in all its essential features the development of the eggs fertilized with sperm. These two methods consisted, first, in putting the eggs for about two hours in hypertonic sea water (the method used in the early experiments) and, second, in exposing the eggs for from one to two minutes to sea water, to which a certain amount of acetic acid or formic acid had been added. When the old method alone was used the eggs did not form a membrane, nor did the larvas rise to the surface. When the acid treatment alone was used, the eggs formed a membrane and after about six hours divided into from two to six cells, but then died. When the eggs were exposed to the acid for only a short time, *e. g.*, for three-fourths of a minute, not all the eggs formed a membrane when put back into normal sea water; and in this case only those divided into two or four cells and subsequently died within 20 hours, which had formed a membrane, while those eggs which had not been exposed long enough to the acid to form a membrane neither segmented nor died. If both methods of treatment were combined, however, those eggs which had formed a membrane developed at about the same rate as the eggs fertilized

with sperm. A certain percentage of these eggs rose to the surface of the water in the usual way, while the eggs which had not formed a membrane either did not develop at all, or developed in the somewhat abnormal and slow way characteristic of the treatment by hypertonic sea water alone.

The reader will notice that the eggs were submitted first for about two hours to the hypertonic sea water and then exposed to the acid. When the order was reversed, and the eggs were exposed to the acid first and afterward to the hypertonic sea water for about two hours, most of them died without developing. This seemed rather strange, in view of the fact that in the case of sperm fertilization, the membrane formation is the first act in the series of events, while in the above-mentioned experiments it was the last. It occurred to the author that by shortening the time of exposure of the egg to the hypertonic sea water, he might also accomplish the last postulate of a complete imitation of the process of fertilization by physico-chemical means, namely, to get the order of events identical in both cases. This idea proved correct. It was found that when the unfertilized eggs were exposed for about one to two minutes to 50 c.c. of sea water, to which about 3 c.c. $n/10$ acetic acid were added, the majority of the eggs formed the membrane characteristic of the entrance of the spermatozoön. If these eggs were afterward exposed for from 30 to 40 minutes to 100 c.c. of sea water, to which 14 c.c. or 15 c.c. of a $2\frac{1}{2}n$ solution of NaCl were added, those of the eggs which had formed membranes developed into swimming larvas that rose to the surface. The author has raised these larvas and they develop into perfect plutei as fast as the larvas of eggs fertilized with sperm.

It is very remarkable that when the order is reversed and the eggs are put first into the hypertonic sea water for about 40 minutes, and then into the acidulated sea water for about one or two minutes, not a single larva is formed, and the eggs behave on the whole as if they had been exposed to the acid alone. If it is desired to put the eggs into the hypertonic sea water first and then expose them to the acid, it is necessary to expose them to the hypertonic sea water at least an hour and a half in order to obtain larvas. On the other hand, if the eggs are treated with acid first and then exposed to the hypertonic sea water for from an hour and

a half to two hours, most of the eggs die in the early stages of development.

It may also be mentioned in this connection that if eggs are fertilized with sperm first and then exposed to the hypertonic sea water of the above mentioned concentration for about two hours, many more eggs will die without reaching the larval stage than when the order is reversed. It is therefore obvious that the process of membrane formation caused by the spermatozoön modifies the sensitiveness of the egg to the hypertonic sea water in the same sense as the process of membrane formation caused by the acetic acid. If eggs are fertilized with sperm and then exposed to the hypertonic sea water for from about thirty to forty minutes, their development becomes almost identical with that of the unfertilized eggs treated first with acid and then exposed to the hypertonic sea water for the same period of time. The majority of these eggs segment and develop in a normal way.

2. The question arises as to how far the division of labor between the two agencies used in these experiments goes. Does the treatment with acid cause only the formation of the membrane, or does it also set the internal mechanism of nuclear and cell division into motion? And what is the rôle of the treatment with hypertonic sea water? From the author's earlier experiments he had expected that the latter was required to cause the internal changes necessary for karyokinesis. The direct observation, however, of the eggs treated in the above-mentioned way with acetic acid, shows that the acid treatment causes the formation not only of the membrane, but also, in due time, of the karyokinetic spindle; while the eggs exposed for only thirty or forty minutes to the hypertonic sea water do not show any karyokinetic changes nor, in fact, changes of any kind.

It is a striking fact that the spindle formation which can be observed in the living egg of *Strongylocentrotus* seems to be identical in the cases of the fertilized egg and the unfertilized egg treated with acetic acid in the above-mentioned manner. The rôle which the subsequent treatment with hypertonic sea water for from thirty to forty minutes seems to play, is, in the first place, the acceleration of the process of segmentation. When the eggs are treated first with acid and then for about thirty or forty minutes with

hypertonic sea water, they begin to segment at a temperature of about 19° C., in from an hour to an hour and ten minutes after they have been removed from the hypertonic sea water. After this they go on segmenting at the rate and usually in the manner characteristic of the fertilized egg. The eggs treated with the acetic acid alone, after having formed a membrane, do not begin to segment for about five or six hours (if they segment at all) and they do not develop beyond the four or eight-cell stage, dying as a rule within twenty hours. The treatment with hypertonic sea water, therefore, first accelerates the mechanism of cell division originated by the acid treatment, and second, indirectly through or in addition to this acceleration, increases the vitality or prolongs the life of the egg.

It is not yet possible to say how the acid brings about its effects. Several years ago the author ventured the suggestion that the process of membrane formation was due to coagulation. The author's recent experiments, however, contradict such an assertion, inasmuch as the membrane formation never occurs while the eggs are in the acidulated sea water of the above-mentioned concentration, but only after they are taken out and put back into normal sea water. If the process of membrane formation were due to coagulation by acid, it should occur while the eggs are in the acidulated sea water.

The author considers it possible (but far from proved) that the membrane formation by the spermatozoön and possibly the subsequent process of karyokinesis are due to the transitory action of an acid carried by the spermatozoön into the egg or produced transitorily by the spermatozoön in the egg ; and that, in addition, the spermatozoön carries a second agency or substance into the egg, which supplies some of the conditions produced in the above experiments by the brief treatment with hypertonic sea water.

Twelfth meeting.[1]

Laboratory of Clinical Pathology at the Cornell Medical College. May 24, 1905. Vice President Dunham in the chair.

34 (80). **"Contributions to the study of sulfur. 1. The metabolism in brombenzol poisoning": W. MACKIM MARRIOTT** and **C. G. L. WOLF.**

Baumann and his pupils investigated the effect of the adminis-

[1] Reprinted from *Science*, 1905, xxi, p. 986 ; *American Medicine*, 1905, ix, p. 026 ; *Medical News*, 1905, lxxxvii, p. 520.

tration of the halogen derivatives of the hydrocarbons, and found that one of the results in the disturbance which followed was the elimination of halogen aromatic mercapturic acids, which were regarded as derivatives of cystin. Later, Friedmann investigated these compounds and was able to confirm Baumann's view. The mercapturic acids are derivatives of cystëin, the reduction product of cystin.

This study is a part of an investigation of cystinuria, the view, which has been advanced by previous observers, being taken that the process in brombenzol poisoning is an experimental cystinuria. Dogs were used in these experiments, and were fed on a uniform diet. The animals were catheterized once a day. Analyses of the urine, as complete as possible, were made. The feces were examined for nitrogen and fats.

During the period of administration of the brombenzol the nitrogen and urea were somewhat increased. The urea followed the total nitrogen closely. The preformed ammonia remained at a level below that of the fore period. The kreatinin estimations did not give results of any distinctness.

The investigation of the partition of sulfur led to the result that, while the total sulfur excretion was not increased during the experiment, there was almost complete suppression of the alkaline sulfates. The excretion of neutral sulfur, represented for the most part in this case by parabromphenyl-mercapturic acid, was increased 400%. The curves representing the alkaline and neutral sulfur were antipodes. The ethereal sulfates rose markedly during the feeding period. In one experiment it was shown that during the first two days of the administration the total sulfur excretion remained constant, while the total sulfate-sulfur fell rapidly. This period is being made the subject of closer study.

The chlorin and phosphorous excretion remained practically constant during the experiment. There was increased nitrogen and fat elimination in the feces.

On section, the animals showed ulceration of stomach and intestines. Microscopically, the liver and kidneys were markedly degenerated. The investigation is being continued.

35 (81). "**On experimentally produced variations in the energy of tumor growth**": **LEO LOEB.** (Presented by **JAMES EWING.**)

Inoculations of different tumors (sarcomas of the thyroid, mixed tumor of the submaxillary gland) through several or many generations have shown that, under the influence of experimental conditions, the energy of tumor growth varies in a definite way. The rate of growth is relatively slow in the animal originally affected by the tumor; after the inoculation into the first generation there is a certain latent period, after which the tumor begins to grow. The growth in the first generation is more rapid than in the original animal. After the inoculation into the second generation the latent period is abbreviated, more or less, and the succeeding growth is likewise more rapid than the growth in the original animal, or in the first generation. A further shortening of the latent period, or an increase in the rapidity of tumor growth, does not take place in the succeeding generations. Duration of the latent period and rapidity of growth may remain stationary through many generations, or the energy of the tumor growth may even somewhat decline.

These facts permit the conclusion that transplantation of a tumor has a tendency at first to increase the energy of tumor growth, and that this increase may be cumulative. That this increase does not continue in succeeding generations may perhaps be explained by the existence of counteracting influences, the actual existence of which can be demonstrated, as will be shown later.

The energy of tumor growth can be increased directly, and not only indirectly, merely by removal of the tension of the surrounding capsule or by better conditions of nourishment. Such a direct stimulating effect of the wound upon the cell growth causes probably a phenomenon not infrequently observed by surgeons, namely, the increase of malignancy in recurrent tumors. It is also possible to diminish the energy of tumor growth. In the course of tumor inoculations it not rarely happens that certain tumors remain stationary or apparently even retrogress spontaneously. This is especially found in the course of later inoculations, and it probably indicates that after many inoculations one or several of

the factors determining a vigorous tumor growth become gradually weakened. In such cases one can observe that even a long time after the expansive growth of such a tumor piece has ceased, many mitoses are present in the cells of the stationary or retrogressive tumor.

It is possible to diminish the virulence of tumor cells directly by subjecting them to certain physical or chemical conditions. By heating tumor cells up to 43° C. or 44° C. for half an hour outside the body, or by leaving them before inoculation in glycerin for 12 to 24 hours, and washing them afterward in 0.85% sodium chlorid solution, or by keeping them one or two days in $n/700$ KCN solution, before transplantation, we are able to diminish considerably the energy of the succeeding tumor growth and to increase the period of latency. In the author's recent tumor inoculations of a salivary tumor, a similar action of glycerin in increasing the period of latency was found to occur. Frequently such tumors remain stationary after a short preceding period of growth. In the first experiments of this kind on rat tumors, it was found that a temperature of 45° C. during half an hour kills the tumor cells. Jensen found a similar sensitiveness of his mouse tumors. Sticker's lymphosarcoma could be heated to 45° C. without being killed. The power of resistance of different varieties of tumor cells varies somewhat, therefore, and the means to be adopted to obtain a diminished virulence in the growth of an inoculated tumor will vary accordingly. In this connection it might be mentioned that these facts may perhaps find a practical application, insofar as pieces of tumor previously subjected to such treatment might be used to procure active immunity against tumor growth. That such active immunity is possible, at least in the case of certain tumors, is especially indicated by the observations of Sticker.

If now we wish to analyze the cause of this decrease in the rate of growth of tumor cells we have to consider several possibilities. It might be that the physical or chemical means employed kill most of the cells, and leave only a few cells alive and able to give origin to the developing tumor. Two facts speak against such an interpretation. In the case of any tumor transplantation, the growth starts from a relatively small number of cells, inasmuch as the central part of the transplanted piece becomes necrotic. In

his first series of tumor transplantations the author obtained well growing tumors after injection of cystic tumor-fluid into rats. In such cases one or very few cells must have given rise to the tumor growth, and these tumors developed in a few cases quite rapidly. Such an explanation is, therefore, improbable. Further, we would have to consider the possibility that the means employed to decrease the virulence of tumor cells are favorable to the growth of bacteria, and that they inhibit in this way the development of tumors. It is certain that bacterial toxins frequently act unfavorably upon the growth of tumors. Against this explanation, however, the objections can be raised that tumors with experimentally diminished virulence did not show any sign of putrefaction, nor did they, after inoculation, cause a formation of abscesses, occurrences which are frequent after transplantation of infected material.

It is, therefore, most likely that the cause of this decrease in virulence is the result of the direct decrease of the vitality of the tumor cells as expressed in their energy of growth. It is, however, desirable to further analyze these facts in future experimental work on tumors, especially as the character of such work necessarily limits greatly the number of experiments a single observer can make. With this restriction it may be stated that the observations here recorded point to the conclusion that it is possible to cause an experimental increase or decrease in the energy of tumor growth, that these variations may be caused by a direct stimulating or depressing influence upon the tumor cells, and that such a stimulating effect may be cumulative.

36 (82). "**Demonstration: Photographs and plumage-charts of hybrid poultry,**" with remarks: **CHARLES B. DAVENPORT.**

Dr. Davenport exhibited photographs and plumage-charts of four hybrids between different races of poultry, and also of their parents, and remarked on the nature of the inheritance illustrated by each example.

37 (83). "**Experimental cirrhosis of the liver**": **RICHARD M. PEARCE.** (Presented by **EUGENE L. OPIE.**)

The experimental studies upon which this communication is based were suggested by an investigation of the necrosis produced

in the liver of the dog as the result of injecting hemolytic immune sera of high hemagglutinative power.[1] These necrotic lesions, which are due apparently to an obstruction of the circulation by thrombi composed of fused red blood-corpuscles, vary in position and extent, according to the dose of serum administered. Small doses cause more or less isolated lesions which may occupy any portion of the lobule; large doses produce a diffuse necrosis which spares only the tissue about the larger portal spaces. The uniformity of this necrotic lesion suggested the importance of a study of the repair process which would naturally follow in animals recovering from the acute toxic effects of the injected serum. The extent of the destruction precluded complete regeneration of liver parenchyma, and if the defect was repaired by connective-tissue proliferation, the resulting histological picture would be, except for a difference in the relation between the new tissue and the remainder of the lobule, analogous to cirrhosis in man.

Methods. — Dogs were injected either in the smaller branches of the femoral vein, or in the abdominal cavity, with serum obtained from rabbits which had received repeated injections of red blood-corpuscles of the dog. The dose usually employed was 1 c.c. of serum to from 500 gm. to 800 gm. of body-weight, and the animals were killed at intervals varying from 48 hours to 36 days

Results. — A majority of the animals die after intervals varying from 4 minutes to 48 hours. In those surviving, hemoglobinuria was a constant phenomenon usually appearing within 18 to 24 hours, persisting 3 to 4 days, and followed for several days by the presence of bile pigment in the urine. The first evidence of repair was mitosis of the liver cells lying at a slight distance from the necrotic areas. The earliest period at which this was seen was 38 hours after injection. At 48 hours the poliferation of endothelial and connective-tissue cells was evident, and this increased so rapidly that by the fifth day the necrotic tissue was largely replaced by young granulation tissue in the midst of which dividing liver cells could be found in considerable number. The young tissue later assumes a more fibrous appearance, the new blood-vessels become prominent, and newly formed bile ducts appear in the midst of the stroma. A development of liver cells from these

[1] *Journal of Medical Research*, 1904, xii, 329.

new bile ducts is readily demonstated. Multinucleated liver cells containing four to twelve nuclei are very abundant in the late stages. An interesting pheomenon is the englobing and removal of the hyaline remains of necrotic liver cells by large multinucleated masses of protoplasm. These giant cells, essentially foreign body giant cells, are derived in part from endothelial cells, but many have all the characteristics of true hepatic cells and are, undoubtedly, multinucleated liver cells with phagocytic properties.

The oldest lesion obtained (thirty-sixth day) presented an appearance analogous in histological structure to early cirrhosis as seen in man, differing only in that the new connective tissue surrounded the island of liver tissue persisting about the portal spaces, instead of having a distinctly perilobular arrangement. Macroscopically, this liver was much firmer than normal, deeply bile stained, and had a finely granular surface. Thus we have a form of experimental cirrhosis affecting the liver in a diffuse but uniform manner, and more typical than any previously described in the literature.

The observations thus briefly outlined, while of importance in explaining the histogenesis of cirrhosis, and incidentally of various processes of repair in liver tissue, do not aid in the elucidation of the etiology of cirrhosis in man, nor do they explain the peculiar arrangement of the connective tissue in human cirrhosis. They demonstrate, on the other hand, however, that cirrhosis may follow extensive primary destructive lesions, a view not yet fully accepted, and thus support the contention of Kretz that cirrhosis is essentially the result of a series of repair processes following repeated injuries of liver parenchyma.

The earlier lesions closely resemble acute yellow atrophy of the liver in man and appear to be of considerable importance in explaining the pathogenesis of this process.

38 (84). **"Experimental arteriosclerosis": RICHARD M. PEARCE** and **E. McD. STANTON.** (Presented by **J. E. SWEET.**)

Within the past two years several French and German writers (Josué, Erb and others) have described under the various names of calcification, atheroma or arteriosclerosis, a lesion of the aorta of rabbits produced by the intravenous injection of adrenalin.

These experiments have been repeated for the purpose of making detailed histological studies and in the hope of throwing some light upon the histogenesis of arteriosclerosis in man.

Methods. — Rabbits have received injections of a 1 to 1,000 solution of adrenalin in the ear vein. An initial dose of 3 m. repeated every other day has been the usual procedure. In other instances, the dose has been gradually raised until a dose of 20 m. to 25 m. was given every day. The animals have been killed after periods varying from a few days to eight weeks.

Results. — The vascular lesions produced are limited to the aorta and exhibit a more or less definite sequence. Rabbits receiving five to six injections show no gross lesions, but histologically important changes in the media are evident. These consist of focal areas of degeneration in which the muscle fibers are destroyed without alteration of the elastica. Later the degeneration is more extensive and involves the greater portion of the middle zone of the media. At this time changes in the elastic tissue appear; the fibers become swollen, stain irregularly and in some places appear to be fused together. Special stains show a small number of minute fat droplets in such areas. After twelve to fifteen injections very definite lesions are evident macroscopically. The aorta is more or less distorted, rigid and nonelastic. Irregular dilations alternate with elevated brittle areas of calcification. Distinct atheroma with ulceration is seldom seen. In the experiments continued for six to eight weeks, the process becomes very diffuse and small dilations of the thinner portions of the aorta assume the appearance of aneurysms. At this stage the destruction of the elastic fibers is extreme and all degenerated areas are infiltrated with lime salts. Cellular infiltration and repair about such areas have been seen in a few instances, and experiments are now under way to determine the frequency and extent of this reparative process.

The changes in other organs include enlargement of the heart, edema and congestion of the lungs, also degenerative changes in the liver and kidney, and occasionally in the heart and other muscles.

Whether the vascular changes are due to a primary toxic action of the adrenalin or whether they are the result of the increased

arterial tension which it causes, cannot be determined from these experiments. This question of etiology must be settled by other methods of investigation. The chief value of the studies herein briefly summarized lies in the application of this comparatively simple series of changes to the more complicated vascular lesions occurring in the arteriosclerosis of man.

39 (85). **"On the chemical and physiological properties of ricin,"** with demonstrations: **THOMAS B. OSBORNE** and **LAFAYETTE B. MENDEL.**

A chemical study of the castor bean has indicated that this seed contains proteins of the same character as the other oil-seeds which have been examined, namely, (1) a considerable quantity of a globulin which can be obtained in octahedral crystals; (2) a much smaller quantity of an albumin, coagulating at about 60° C. to 70° C., the temperature at which it separates depending to a large extent on the rate of the heating and other conditions; (3) proteoses which appear to belong to several of the now recognized groups of this class of substances. The satisfactory separation of the various types of proteins was accomplished largely by the use of fractional salt precipitation and dialysis.

The toxic constituent of the castor bean has been investigated under Kobert's guidance by Stillmark, who applied the name *ricin* to protein material which he separated. The product which Stillmark regarded as relatively pure must have been a mixture of proteins and have contained only a small proportion of the toxic compound. Cushny made a more careful study of ricin and obtained a substance of sufficient toxicity to produce death in animals with a dose of 0.04 mg. per kilo of body-weight. He regarded the toxic compound as protein in nature. Among subsequent investigators, Jacoby has denied the protein character of ricin. He digested his toxic preparations with trypsin and obtained solutions which retained their toxicity although apparently no longer giving protein reactions. Brieger, however, failed to prepare toxic preparations free from protein material.

The efforts of the authors have been directed especially to the possibility of isolating the toxic constituent of the castor bean and determining its chemical nature. The toxic action has been found to be associated wholly with the preparations containing the coagu-

lable protein and never with those free from the *albumin* already mentioned. The toxicity of the products consisting chiefly of this albumin was extremely great, the most active preparation proving fatal when administered subcutaneously to rabbits in the small dose of 0.0005 mg. per kilo of body-weight. Each sample of ricin prepared by the authors showed in marked degree characteristic agglutinating properties in its behavior toward erythrocytes; and the pathological findings after intoxication were typical. The other proteins of the seed are devoid of the properties noted for ricin, thus demonstrating the applicability of the methods of separation employed. The toxicity of the active preparations is proportional to the content of coagulable albumin, the purest specimens containing, as their analysis shows, little else than protein. Thus far their determinations have shown that the ricin prepared by the authors does not differ from ordinary proteins in composition, heat coagulation, color reactions, precipitation reactions, specific rotation, or in the state of combination of its nitrogen. By tryptic digestion the agglutinating power and toxicity of pure ricin may be greatly impaired or destroyed. The experience of the authors lends no encouragement to the attempts to "purify" such toxins by methods designed to eliminate protein substances from the active materials.

40 (86). "**On a method of determining indol,**" with demonstrations: **C. A. Herter** and **M. Louise Foster.**

The method described by the authors constitutes a rapid and accurate means of determining indol. It is based on the fact that indol, in slightly alkaline solution, readily condenses with naphthoquinon sodium mono-sulfonate, and forms a blue crystalline compound which is only very slightly soluble in water and is readily extracted by chloroform from a watery solution or suspension. The condensation compound results from the union of two molecules of indol with one of the naphthoquinon compound. The union does not occur as in the case of compounds with amins, with the elimination of the sulfonic acid group, but occurs between one of the carbonyl groups of the naphthoquinon compound and the imid group of the indol. The new compound is, therefore, a di-indyl naphtho-ketone mono-sulfonate. The solubility of this substance in chloroform is about one part in 4,000 of the solvent, and is suffi-

ciently great to permit a rapid and thorough extraction of the substance. Chloroform containing the di-indyl compound has a red color, very like that of hemoglobin. Owing to this circumstance, the condensation compound in chloroform can be approximated colorimetrically in a convenient manner by comparing the tint of the solution with that of the orange-red glass scale of the Fleischl hemoglobinometer. When more accurate results are desired, the chloroform is evaporated and the residue of the di-indyl compound weighed.

It was found that the method here indicated serves for the recovery of a very large percentage of indol from peptone solutions or bouillon. From solutions containing a little protein, the indol may be recovered almost quantitatively. The presence of a large proportion of protein may cause the retention of considerable indol. The distillation should be carried on directly, without steam, from the acidified fluid. The presence of indol in a small fraction of distillate is best ascertained by boiling the acid solution with a few drops of a 2 per cent. alcoholic solution of di-methyl amido-benzaldehyde.

Skatol forms an homologous and similar compound with the naphthoquinon reagent, but this substance is violet rather than blue.

41 (87). **"Anesthesia produced by magnesium salts,"** a preliminary communication, with demonstrations: **S. J. MELTZER** and **JOHN AUER.**

The authors exhibited to the society two guinea-pigs, which were deeply narcotized by injections of magnesium sulfate. One of these animals had been similarly narcotized twice before, and fully recovered each time. In their physiological and toxicological studies of magnesium salts, the authors found that by subcutaneous injections of certain quantities of sulfate or chlorid of magnesium, animals can be brought into a state of deep anesthesia, during which any operation can be performed upon them without the least resistance. If the dose of the salts is not too large, heart-beat, blood-pressure and respiration remain nearly normal. It was tested on dogs, cats, rabbits, guinea-pigs, white rats and frogs. A gram and a half of magnesium sulfate is about the effective dose for most of the animals. The chlorid has to be used in smaller

doses in proportion to its smaller molecular weight. Particulars will be reported later. The authors emphasized the fact that these salts are very poisonous when certain maximum doses are exceeded.

42 (88). **"Enzymes and anti-enzymes of inflammatory exudates": Eugene L. Opie.**

Exudates obtained by injecting suspensions of aleuronat into the pleural cavities of dogs and rabbits were subjected to autolysis. The Kjeldahl method was used to determine the nitrogen of coagulable proteins converted by digestion into soluble form.

Inflammatory exudates removed one or two days after injection of the irritant undergo very little change, while those removed three or four days after the onset of inflammation exhibit appreciable though slight autolysis. There is no relation between the amount of digestion and the number of cells which are present. If the cells are separated by centrifugalization from the serum and suspended in normal salt solution, well-marked autolysis is demonstrable. By recombining cells and serum it can be shown that the serum inhibits this autolysis. When this inhibitory action is prevented by heating serum to 100° C., leukocytes acting upon the coagulated serum cause very active digestion. In the following experiments nitrogen of uncoagulable substances is represented by cubic centimeters of $\frac{n}{10}$ sulfuric acid:

	c.c. $\frac{n}{10}$ H_2SO_4.
5 c.c. suspension of cells at 37° C., 5 days	9.30
Control	3.60
5 c.c. serum	7.25

5 c.c. cells + 5 c.c. serum, at 37° C., 5 days	10.95
Control	10.85
5 c.c. cells + 5 c.c. coagulated serum, at 37° C., 5 days	23.10

The anti-enzymotic action of the serum is unaffected by a temperature of 65° C., but is prevented at 75° C. The proteolytic ferments of the leukocytes act both in an acid and in an alkaline medium, but are most efficient in the latter. The anti-enzymotic action of the serum is favored by an alkaline reaction, but is completely prevented in an acid medium. The serum of the exudate contains a proteolytic ferment, which is active only in an acid

medium. These facts are illustrated by the following summary of an experiment, in which 5 c.c. of a suspension of cells with serum, of cells with heated serum, and of serum alone, were kept at 37° C. for five days:

	Cells + Serum. c.c. $\frac{n}{10}$ H_2SO_4.	Cells + Coagulated Serum. c.c. $\frac{n}{10}$ H_2SO_4.	Serum. c.c. $\frac{n}{10}$ H_2SO_4.
With 0.2 per cent. sodium bicarbonate.	8.0	35.15	6.25
Reaction unchanged.....	9.9	27.00	4.60
With 0.2 per cent. acetic acid.....	33.8	26.30	13.75

The anti-enzymotic power exhibited by the serum of the inflammatory exudate is possessed by the serum of the blood, from which it doubtless passes into the exudate. In the later stages of inflammation produced by aleuronat, and in exudates caused by bacteria, there is some diminution of the anti-enzymotic action.

43 (89). **"Shallow well-waters of Brooklyn": JAMES P. ATKINSON.**

Many streets of Brooklyn are without a public water-supply and a sewage system. The residents of these streets are therefore dependent upon wells for their water-supply, and upon privy vaults and cesspools to remove the sewage and waste water of their homes. The soil is uniformly sandy and water may be had by driving a pipe or digging a few feet below the surface. The water obtained is to a certain extent surface water. The underground water is necessarily influenced by the sea water. This influence is very marked in some instances, as is shown by the high chlorin content, accompanied by the low contents of other constituents that could indicate sewage contamination.

The following tables present average analytic data regarding condemned shallow wells, also regarding wells considered to be of a suspicious quality and wells which were passed as being of fair quality. Very few of the latter class were considered to be of good quality, and some might possibly have been classed as suspicious upon their high nitrate contents, considered with the proximity of the sources of contamination.

Tables giving average, and high and low results of analyses of 438 shallow wells in Brooklyn, N. Y., which are used for domestic purposes; also similar analytic data obtained for 14 deep wells used for manufacturing purposes. The figures represent parts in 100,000.

A.—82 Contaminated Well Waters.

	Cl.	NO_2.	NO_3.	Free NH_3.	Alb. NH_3.	Total Solids.	Loss on Ignition.	Depth of Well.	Distance From Source of Contamination.
A	4.64	0.0018	0.70	0.0236	0.0045	31.92	5.20	29 feet.	47 feet.
L	0.70	.0001	0.30	Trace.	.0004	12.30	1.30	15 "	10 "
H	9.00	.0100	3.60	.4900	.0400	60.80	17.00	65 "	150 "

B.—59 Suspicious Well Waters.

A	5.33	0.0006	0.634	0.0057	0.0035	34.82	5.49	27 feet.	45 feet.
L	0.80	.0004	Trace.	Trace.	Trace.	7.90	0.40	8 "	20 "
H	32.00	.0025	2.400	.0875	.0180	222.90	34.40	45 "	75 "

C.—297 Uncontaminated Well Waters.

A	2.94	Trace.	0.582	0.0026	0.0031	28.41	4.86	27 feet.	43 feet.
L	0.40	None.	Trace.	Trace.	Trace.	7.50	0.30	6 "	10 "
H	12.10	.0003	3.600	.0190	.0270	101.50	39.50	52 "	100 "

D.—14 Uncontaminated Deep Well Waters for Brewery and Factory Use.

A	5.60	Trace.	0.300	0.0010	0.0020	50.20	15.00	100 feet.	
L	0.80	None.	0.040	Trace.	Trace.	13.70	4.90	55 "	
H	17.00	.0002	0.400	.0030	.0065	101.90	30.70	227 "	

A, average figure. L, lowest figure used in average. H, highest figure used in average.

The highest and lowest figures which enter into the averages are also given. These figures do not represent any particular analyses, but are selected from the different results from which the averages were made. Table D gives the average data for deep wells that supply water for manufacturing purposes. These data may be used as standards in judging the purity of wells whose waters are used for domestic purposes.

Of these waters, 67.9% were considered to be of good quality; 13.4% were considered to be of suspicious quality; 18.7% were considered to be contaminated and unfit for domestic purposes. It was found impossible, as a rule, to use the figures for chlorin and ammonia contents of these Brooklyn waters in judging their purity. The nitrates might give some clue to the condition, but it was mainly upon the nitrites that one had to depend. There was in each case of condemnation ample chance of pollution through

privy or cesspool, and in many cases there were other sources, such as stables for horses and cows, pig sties, chicken yards, etc. When the nitrites were as high as 0.001 parts per 100,000 the water was condemned. When the nitrites ranged between 0.0003 and 0.001 parts per 100,000, the water was considered to be of suspicious quality and warning was given to boil before using for domestic purposes. In Brooklyn and Queens there are waters of known purity which show nitrites as high as 0.0003 parts per 100,000. Therefore, when nitrites amounting to 0.0003 parts per 100,000 were found, with other constituents of the water suitably low, such waters were passed as fit for domestic purposes.

It will be noticed on comparing the average figures in tables A, B and C, that nitrites decrease with ammonia, and that the figures for nitrates are about the same in each table. The average chlorin in table C is much lower than in tables A and B, while the average depths of the wells and their average distances from the sources of contamination are about the same. The nitrogen averages in table C approach those in table D. If one takes the nitrogen figures of the deep wells as a standard, the conclusion may be drawn (1) that the sandy soil of Brooklyn cannot be relied upon as a safe filter; (2) that Brooklyn soil in populous districts, so far as the author's evidence goes, seems to be nearing the saturation point with sewage; and (3) that, consequently these shallow wells are in growing danger of pollution.

44 (90). **"The influence of the external temperature upon the viscosity of the blood": RUSSELL BURTON-OPITZ.**

It was proved by a series of determinations that the viscosity of the "living" blood can be greatly influenced by changing the temperature of the surrounding medium. The viscosity was found markedly increased, if the dogs used in the experiments were immersed in water at 25° C. Warm water baths (42° C. to 45° C.) produced a corresponding decrease in the viscosity. The specific gravity of the blood was changed in a corresponding manner.

45 (91). **"The changes in the viscosity of the blood during narcosis": RUSSELL BURTON-OPITZ.**

Determinations of the viscosity of the "living" blood were made during deep and light ether and chloroform narcosis. It

was found that the viscosity is increased by deep and lessened during light narcosis. The specific gravity of the blood also shows regular variations. It is increased by deep and lessened by light ether narcosis. Chloroform, on the other hand, produces a slight decrease during deep and an increase during light narcosis. Hence the specific gravity cannot be regarded as an accurate index of the viscosity.

46 (92). **"Studies of the effects of radium on plants and animals,"** with demonstrations: Communicated by **William J. Gies.**

The various studies of the effects of radium that are included in this communication were carried out at the writer's suggestion and under his general direction. All of them are still in progress. They were made possible by the generosity of Mr. Hugo Lieber, who gave the writer an abundant supply of radium bromid for each series of experiments. Professor William Hallock also encouraged the work by permitting the use of some of his valuable samples of radium bromid and radioactive substances. Dr. G. B. Pegram has given advice freely on physical matters connected with radioactivity. The studies included in this plan were the following (I–V):[1]

I. *"Preliminary notes on the effects of radium rays on plants":* C. Stuart Gager (New York Botanical Garden).

The radium (bromid) has been employed in several forms, and in degrees of activity ranging from 10,000 to 1,500,000. Experiments so far indicate that the effect is the same in kind, whether the plants are stimulated with gamma rays only, or with alpha and beta rays as well. When three kinds of rays are employed the effects, within the same time, seem to be increased. The results already obtained justify the following statements:

The rays of radium act as a stimulus to plants. For this stimulus there are minimum, optimum, and maximum points, depending upon the proximity of the radium to the plant, the strength, quantity, and condition of the radium salt, the time of exposure, and the nature and state of the tissue.

The early stages of seed germination are accelerated, if stimulation ranges between the minimum and optimum points, otherwise

[1] Each of the collaborators has written the report of his own share of the investigations.

they are retarded. Seeds are less sensitive to the rays when dry than when soaked. When germinating seeds are exposed to radium at short distance, germination and subsequent growth are retarded, but when the distance between the radium and the seeds is increased and a screen of metal is interposed, growth is accelerated. Radium rays acting through soil in which plants are growing accelerate both germination and subsequent growth of the shoot, and increase the number and length of root hairs.

The growth of plants is retarded in an atmosphere of decaying radium emanations, such as may be drawn from tubes lined with Lieber's "radium coating." [See page 32 (96).] Development of leguminous tubercles is retarded when a glass tube of radium bromid (10,000 activity) is in the soil. Experiments to obtain radiotropic response have so far given negative results. Alcoholic fermentation is accelerated by radium rays.

Chloroplasts, under the influence of the rays, change their position in the cell, as when exposed to too intense sunlight. Plastids are soon over-stimulated, and their activity completely inhibited, causing etiolation and other attendant effects. Gemmæ of *Lunularia*, exposed for six days, failed to develop thalli. Meristem (embryonic tissue) of the hypocotyl is destroyed by prolonged exposure to the rays.

II. "*The action of radium rays on Amœba proteus and upon other microörganisms*": LOUIS HUSSAKOF (Laboratory of Zoölogy, Columbia University, and the American Museum of Natural History).

These experiments were intended primarily to show the influence, if any, of radium rays on the protoplasm of *Amœba proteus*. Other microörganisms (*Vorticella*, *Paramecium*, etc.) were also subjects of experiment. Radium bromid preparations of 600, 1,000, 10,000, and 1,500,000 activity (in thin glass tubes) were used, and several celluloid rods covered with Lieber's "radium coatings' [page 32 (96)] of 10,000 to 25,000 activity were also employed. The radium container was held in the water within from 1 mm. to 3 mm. of the organism under observation.

Under these conditions no visible effects were produced, by even the strongest radium preparations, during periods of observation of about an hour. The water surrounding the animal may have prevented radiant effects.

III. "*The effects of intravenous injections of radium bromid*": Russell Burton-Opitz and G. M. Meyer (Physiological Laboratory, Columbia University).

These experiments, dealing principally with the effects of radium bromid upon the circulation and respiration, were performed upon dogs weighing from 4 to 5 kilos. Light ether-narcosis was employed. The solutions injected contained 1.8 mg. of radium bromid per c.c. of distilled water. Preparations of radium bromid of 240, 1,000, and 10,000 activity were used. The facial vein was selected for the injections.

Injection was always followed, after a latent period of about five seconds, by a gradual and well marked increase in blood-pressure, this rise evidently being caused by general vaso-constriction. Soon, however, a marked decrease in the frequency of the heart, accompanied by a pronounced irregularity, causes a fall in pressure. Contractions in which the diastolic phase is extremely conspicuous interchange with a series of forcible preëminently systolic beats. It need hardly be mentioned that under these conditions the variations in blood-pressure are extreme. These effects of radium occur also after both vagi have been divided.

The circulatory effects are accompanied by a gradual decrease in the frequency of respiration, terminating finally in complete respiratory paralysis. This effect precedes the total inhibition of the heart.

All ordinary preparations of radium salts contain barium. In order to check the effects of such impurities, the authors carried out a number of comparative experiments with pure barium bromid. It was found that the effects of radium bromid preparations of low activity (240 and 1,000) differ only quantitatively from those of barium bromid. Certain amounts of such radium preparations produce effects that can be obtained only by correspondingly larger amounts of barium bromid. The influence of barium in causing pronounced irregularity of the heart is not evidenced by the preparations of radium bromid of 10,000 activity; only a marked inhibition results, which is accompanied by a decided rise in blood-pressure.

IV. "*The radioactivity of the different organs after intravenous injections of radium bromid*": Gustave M. Meyer (Laboratories of Physiological Chemistry and Physics, Columbia University).

The radioactivity of the different organs of dogs experimented upon was determined by two methods. For an approximate estimation of radioactivity, the gold leaf electroscope has been found very serviceable. In this case, it is only necessary to thoroughly dry the finely divided organ and note the rapidity with which the charged gold leaf descends. The use of the quadrant electrometer admits of a more exact valuation of the radioactivity. The organ is incinerated and the radioactivity of the ash determined.

The determinations thus far made have been entirely upon the dogs used in the experiments of Burton-Opitz and Meyer (III). The following parts have been examined: Blood, liver, lungs, kidney, spleen, pancreas, brain, and muscle. Of these, the blood showed the greatest activity, while the brain has so far given negative results.

Injection as well as feeding experiments are in progress.

V. "*The influence of radium bromid on metabolism in dogs*": WILLIAM N. BERG and WILLIAM H. WELKER (Laboratory of Physiological Chemistry, Columbia University).

The experiments are being carried out on dogs in nitrogenous equilibrium. Radium bromid preparations of 240, 1,000, and 10,000 activity have been employed. Thus far introduction has been by mouth only. One animal (6.6 kilos) has been fed 1.1 gm. 240 activity, 0.25 gm. 1,000 activity, and 0.125 gm. 10,000 activity in small amounts daily (during 12 days), without causing any gross symptoms, except diarrhea during the period of administration of the preparation of 240 activity with its large content of barium. Protein metabolism did not appear to be materially affected. Total sulfate (SO_4) in the urine was markedly increased, especially during the period following the administration of the preparation of highest activity, and when diarrhea as well as constipation was entirely absent.

In control experiments with barium bromid, much larger quantities per os (as much as 0.5 gm. daily to a dog weighing only 4.5 kilos) were without any gross symptoms whatever. In the case of barium, also, protein metabolism was practically unaffected by the quantities used. The quantity of total sulfate in the urine, unlike the result with radium, appeared to be practically unaffected by the barium bromid.

Injection experiments with both barium and radium will soon be completed.

RECAPITULATION OF THE NAMES OF THE AUTHORS AND OF THE TITLES OF THE REPORTS.

Abel, J. J. [with **R. de M. Taveau.**]

53. On the decomposition products of epinephrin. [Presented by **W. J. Gies.**]

Atkinson, J. P.

89. Shallow well-waters of Brooklyn.

Auer, John [with **S. J. Meltzer.**]

61. On the rate of absorption from intramuscular tissue.

87. Anesthesia produced by magnesium salts.

Beer, Theodor [By invitation.]

47. The accommodation of the eye.

Berg, William N. [with **William H. Welker.**]

92 (V). The influence of radium bromid on metabolism in dogs. [Communicated by **W. J. Gies.**]

Brown, E. D. [with **Torald Sollmann.**]

69. A preliminary communication on the pharmacology of thorium. [Presented by **W. J. Gies.**]

Burton-Opitz, Russell

90. The influence of the external temperature upon the viscosity of the blood.

91. The changes in the viscosity of the blood during narcosis.

92 (III). [With **Gustave M. Meyer.**] The effects of intravenous injections of radium bromid. [Communicated by **W. J. Gies.**]

Calkins, G. N.

50. [For **F. G. Novy and W. J. MacNeal.**] Trypanosomes and bird malaria.

72. Rejuvenescence in protozoa.

Chace, Arthur F. [with **W. J. Gies.**]

70. A preliminary study of the toxicological action of thorium.

Davenport, C. B.

52. Some Mendelian results in animal breeding.

82. Demonstration: Photographs and plumage-charts of hybrid poultry, with remarks.

Dryfuss, B. J. [with **C. G. L. Wolf.**]

76. Comparative physiological action of salts of neodymium, præseodymium and lanthanum.

Dunham, E. K.

75. Further observations upon the phosphorized fats in extracts of the kidney. [Presented by **P. A. Levene.**]

Emerson, Haven [By invitation.]

56. A new form of float for water or alcohol manometers.

Ewing, James

67. Structure of vaccine bodies in isolated cells.

81. [For **Leo Loeb.**] On experimentally produced variations in the energy of tumor growth.

Flexner, Simon

49. [For **Jacques Loeb.**] The transformation of negatively heliotropic animals (*Gammarus pulex*) into positively heliotropic animals by chemical means.

63. [For **Hideyo Noguchi.**] The protective action of venom upon blood-corpuscles.

Foster, M. Louise [with **C. A. Herter.**]

86. On a method of determining indol.

Gager, C. Stuart.

92 (I). Preliminary notes on the effects of radium rays on plants. [Communicated by **W. J. Gies.**]

Gies, William J.

53. [For **J. J. Abel and R. de M. Taveau.**] On the decomposition products of epinephrin.

69. [For **E. D. Brown and Torald Sollmann.**] A preliminary communication on the pharmacology of thorium.

70. [With **Arthur F. Chace.**] A preliminary study of the toxicological action of thorium.

79. [For **Jacques Loeb.**] On chemical fertilization.

92 (I–V). [With **Collaborators.**] Studies of the effects of radium on plants and animals.

Hawk, P. B.

78. A report of feeding and injection experiments on dogs after the establishment of the Eck fistula. [Presented by **A. N. Richards.**]

Hektoen, Ludvig

65. Experimental measles. [Presented by **E. L. Opie.**]

Herter, C. A.

58. The reductions in the body in fever.

59. The measurement of the reducing processes of cells in vitro.

60. Some medical applications of the naphthoquinon sodium mono-sulfonate reactions.

86. [With **M. Louise Foster.**] On a method of determining indol.

Hussakof, Louis

92 (II). The action of radium rays on *Amœba proteus* and upon other microörganisms. [Communicated by **W. J. Gies.**]

Lee, F. S.

55. Some of the physical phenomena of muscle fatigue.

73. Temperature and muscle fatigue.

Levene, P. A.

48. [With **L. B. Stookey.**] Preliminary communication on the composition of the liver after subcutaneous injections of liver extracts.

75. [For **E. K. Dunham.**] Further observations upon the phosphorized fats in extracts of the kidney.

Lewis, Joseph [with **H. U. Williams.**]

64. The results of attempts to cultivate trypanosomes from frogs. [Presented by **A. B. Wadsworth.**]

Lieber, Hugo [By invitation.]

54. Radium and some methods for its therapeutic application.

Loeb, Jacques

49. The transformation of negatively heliotropic animals (*Gammarus pulex*) into positively heliotropic animals by chemical means. [Presented by **Simon Flexner.**]

79. On chemical fertilization. [Presented by **W. J. Gies.**]

Loeb, Leo

81. On experimentally produced variations in the energy of tumor growth. [Presented by **James Ewing**.]

Lucas, Daniel R. [By invitation.]

74. On intraureteral pressure and its relation to the peristaltic movements of the ureter.

MacNeal, W. J. [with **F. G. Novy**.]

50. Trypanosomes and bird malaria. [Presented by **G. N. Calkins**.]

Marriott, W. Mackim [with **C. G. L. Wolf**.]

80. Contributions to the study of sulfur. 1. The metabolism in brombenzol poisoning.

Meltzer, S. J.

61. [With **John Auer**.] On the rate of absorption from intramuscular tissue.

68. [With **William Salant**.] On the tetanic element in bile.

77. [With **William Salant**.] The influence of bile upon blood-pressure.

87. [With **John Auer**.] Anesthesia produced by magnesium salts.

Mendel, Lafayette B. [with **Thomas B. Osborne**.]

85. On the chemical and physiological properties of ricin.

Meyer, Gustave M.

92 (III). [With **Russell Burton-Opitz**.] The effect of intravenous injections of radium bromid. [Communicated by **W. J. Gies**.]

92 (IV). The radioactivity of the different organs after intravenous injections of radium bromid. [Communicated by **W. J. Gies**.]

Morgan, T. H.

71. The relation between normal and abnormal development of the frog's egg.

Murlin, J. R.

57. Gelatin as a substitute for protein in the food.

Noguchi, Hideyo.

63. The protective action of venom upon blood-corpuscles. [Presented by **Simon Flexner**.]

Novy, F. G. [with **W. J. MacNeal.**]

50. Trypanosomes and bird malaria. [Presented by **G. N. Calkins.**]

Opie, E. L.

65. [For **Ludvig Hektoen.**] Experimental measles.

83. [For **R. M. Pearce.**] Experimental cirrhosis of the liver.

88. Enzymes and anti-enzymes of inflammatory exudates.

Osborne, Thomas B. [with **Lafayette B. Mendel.**]

85. On the chemical and physiological properties of ricin.

Park, W. H.

51. The gradual decrease in bacteria of the production of agglutinable substance.

62. [For **Theobald Smith.**] Degrees of susceptibility to diphtheria toxin among guinea-pigs. Transmission from parents to offspring.

Pearce, R. M.

83. Experimental cirrhosis of the liver. [Presented by **E. L. Opie.**]

84. [With **E. McD. Stanton.**] Experimental arteriosclerosis. [Presented by **J. E. Sweet.**]

Richards, A. N. [for **P. B. Hawk.**]

78. A report of feeding and injection experiments on dogs after the establishment of the Eck fistula.

Salant, William [with **S. J. Meltzer.**]

68. On the tetanic element in bile.

77. The influence of bile upon blood-pressure.

Smith, Theobald

62. Degrees of susceptibility to diphtheria toxin among guinea-pigs. Transmission from parents to offspring. [Presented by **W. H. Park.**]

Sollmann, Torald [with **E. D. Brown.**]

69. A preliminary communication on the pharmacology of thorium. [Presented by **W. J. Gies.**]

Stanton, E. McD. [with **R. M. Pearce.**]

84. Experimental arteriosclerosis. [Presented by **J. E. Sweet.**]

Stookey, L. B. [with **P. A. Levene.**]

48. Preliminary communication on the composition of the liver after subcutaneous injections of liver extracts.

Sweet, J. E. [for **R. M. Pearce and E. McD. Stanton.**]

84. Experimental arteriosclerosis.

Taveau, R. de M. [with **J. J. Abel.**]

53. On the decomposition products of epinephrin. [Presented by **W. J. Gies.**]

Wadsworth, A. B. [for **Joseph Lewis and H. U. Williams.**]

64. The results of attempts to cultivate trypanosomes from frogs.

Welker, William H. [with **William N. Berg.**]

92 (V). The influence of radium bromid on metabolism in dogs. [Communicated by **W. J. Gies.**]

Williams, H. U. [with **Joseph Lewis.**]

64. The results of attempts to cultivate trypanosomes from frogs. [Presented by **A. B. Wadsworth.**]

Wolf, C. G. L.

76. [With **B. J. Dryfuss.**] Comparative physiological action of salts of neodymium, præseodymium and lanthanum.

80. [With **W. Mackim Marriott.**] Contributions to the study of sulfur. 1. The metabolism in brombenzol poisoning.

Yatsu, Naohidé

66. The formation of the centrosome in enucleated egg-fragments.

EXECUTIVE PROCEEDINGS.

QUOTATIONS FROM THE MINUTES.

Eighth meeting.

Physiological Laboratory of Columbia University, at the College of Physicians and Surgeons. October 19, 1904. President Meltzer in the chair.

Members present: Burton-Opitz, Calkins, Davenport,[1] Ewing, Flexner, Gies, Hiss, Lee, Levene, Levin, Lusk, Mandel, Meltzer, Park, Richards, Salant, Wadsworth, Wallace, Yatsu.

Members elected: J. G. Adami, R. A. Hatcher, Yandell Henderson, G. N. Stewart, C. G. L. Wolf.

Ninth meeting.

Professor C. A. Herter's private laboratory, at 819 Madison Avenue, New York. December 21, 1904. President Meltzer in the chair.

Members present: Atkinson, Auer, Burton-Opitz, Dunham, Ewing, Flexner, Gies, Herter, Jackson, Lee, Levene, Levin, Lusk, Mandel, Meltzer, Murlin, Park, Richards, Salant, Wadsworth, Wallace, Wolf.

Members elected: John Auer, F. G. Benedict, Ludvig Hektoen, G. C. Huber, H. S. Jennings, Jacques Loeb, Leo Loeb, A. B. Macallum, J. H. Pratt, Torald Sollmann, J. C. Torrey.

Tenth meeting.

[Second annual business meeting.]

Rockefeller Institute for Medical Research. February 15, 1905. President Meltzer in the chair.

Members present: Atkinson, Auer, Burton-Opitz, Dunham, Ewing, Flexner, Gies, Jackson, Lee, Levene, Levin, Mandel,

[1] Non-resident.

Meltzer, Noguchi, Norris, Oertel, Opie, Park, Richards, Sweet, Torrey, Wadsworth, Wallace, Wolf, Yatsu.

Members elected: George W. Crile, Haven Emerson, Cyrus W. Field, Hideyo Noguchi, H. C. Sherman, J. Edwin Sweet, Victor C. Vaughan.

Officers elected: President, Wilson; vice-president, Dunham; librarian, Lusk; treasurer, Calkins; secretary, Gies.

Treasurer's report. — The treasurer presented the following report:

I. Receipts: Balance of cash on hand February 17, 1904		$ 4.77	
Annual dues for 1903 (delinquent)		3.00	
Annual dues for 1904		65.15	
Annual dues for 1905 (in advance)		2.00	
Sale of extra copies of Vol. I of the Proceedings (101 copies @ $0.25)		25.25	
Loan from the Treasurer to cover deficit		33.16	$133.33
II. Expenditures: Printed programs		6.75	
Secretary's expenditures for stationery and postage		20.56	
Treasurer's expenses		4.05	
Publication of Vol. I of the Proceedings (500 copies)		101.97	133.33
Balance due the Treasurer			33.16

Increase of annual dues. — The council announced that the annual dues (1904–05) were increased from $1.00 to $2.00.

Eleventh meeting.

Zoölogical Laboratory of Columbia University. April 19, 1905. President Wilson in the chair.

Members present: Adler, Auer, Calkins, Emerson, Gies, Hatcher, Jackson, Lee, Levene, Levin, Lusk, Meltzer, Morgan, Murlin, Richards, Salant, Sherman, Torrey, Wallace, Wilson, Wolf, Yatsu.

Members elected: Harlow Brooks, W. B. Cannon, A. J. Carlson, R. G. Harrison, A. P. Mathews, G. H. Parker, A. E. Taylor.

Volume II of the Proceedings. — The Secretary was instructed to publish in Volume II of the Proceedings a brief biography of the founder and first president of the society.

Twelfth meeting.

Laboratory of Clinical Pathology of the Cornell Medical College. May 24, 1905. Vice President Dunham in the chair.

Members present: Atkinson, Auer, Brooks, Burton-Opitz, Crampton, Davenport,[1] Dunham, Emerson, Ewing, Field, Flexner, Gies, Herter, Levene, Levin, Lusk, Meltzer, Mendel,[1] Morgan, Noguchi, Norris, Oertel, Opie, Richards, Salant, Sweet, Torrey, Wallace, Wolf.

Members elected: Joseph Erlanger, Otto Folin, E. O. Jordan.

Resignation of membership. — Resignation of membership was received from Hugo Münsterberg and accepted with regret.

Amendments of the Constitution. — The amendments referred to on the next page were severally endorsed by at least three members before the opening of the regular session of the society on April 19. They were collectively endorsed by the four members of the council present at the regular council meeting on April 19, and were proposed by the council at the eleventh meeting of the society, for consideration at this or a future meeting.

The following note accompanied the blank ballots that were issued to the members on April 31: "In view of the probability that the first two of these amendments will be approved unanimously, the council suggests that the members be prepared to vote upon them at the next meeting (May 24) and that *informal* expression of opinion be given at the same time on the three remaining propositions. The latter may be modified or rejected of course, at the next meeting, but if they in any form survive discussion, the council would suggest that formal vote on them be deferred until the October meeting. In case any or all of the last three propositions referred to should be generally approved, at the next meeting, as they stand, however, it would be convenient and desirable for the society to decide to make the informal ballot on any or all of the three propositions the *formal* decision of the members."

The amendments and a summary of the votes cast on them are given on the next page.[2]

---

[1] Non-resident.

[2] The total membership was 84 ($\frac{2}{3} = 56$), and 82 votes were cast. The two members who failed to vote were in Europe and could not be communicated with in time for their votes to be recorded. The tellers were Frederic S. Lee, Russell Burton-Opitz and Alfred N. Richards.

Formal Ballot.

Proposed Amendments V and VI.	Returns.		
	Yes.	No.	Non-committal.
V. In sub-section D, Section 3, Article III, *substitute* the word *one* for *two* and change the sub-section to the following: *It shall be the duty of each member to present to the Librarian one copy of every publication of his researches.*	81	0	1
VI. From sub-section C, Section 5, Article V, *strike out* the last sentence relating to the duties of the Librarian. The sentence referred to reads: "He (the Librarian) shall call the roll of membership at the annual business meeting and, at that time, shall announce the publications of each member during the preceding year."	76	4	2

Informal Ballot.

Proposed Amendments VII, VIII and IX.	Returns.		
	Yes.	No.	Non-committal.
VII. Into Section 3, Article III, *introduce* a new sub-section as follows: *F. Any member of this Society who may consent to the use of his name in any way that would aid in increasing the sale of any patent medicine, proprietary food preparation, or any similar product known to be of doubtful value, shall forfeit his membership*	65	13[1]	4
VIII. *Add* to Section 2, Article V, the following: *Ex-presidents of the Society shall be ex-officio permanent members of the Council.*	57	15	10
IX. Into Section 3, Article IX, *introduce*, after the word membership, the phrase, *or a unanimous vote of the members present*, to make the section read: *A two-thirds vote of the total membership, or a unanimous vote of the members present, shall be required for the adoption of an amendment.*	66	11	5

Amendments V and VI, having received a formal two-thirds vote of the total membership were declared adopted. A motion to make the informal vote on amendments VII, VIII and IX the *formal* decision of the society, each having received a two-thirds vote of the total membership, was adopted unanimously.

New By-law. — By-law III, on "Order of Procedure to be followed at the regular meetings," as printed on page 14 (78) of this volume, was adopted by a unanimous vote of the members present, in conformity with Article VIII of the constitution.

[1] Three of these votes were cast by members who stated that they were in favor of the spirit of the amendment but who made verbal changes on their ballots, for which reason their votes were counted in the negative.

INDEX

OF THE

SCIENTIFIC PROCEEDINGS.

[The numerals in this index correspond with the numerals in parenthesis before the titles of the abstracts. Pages are not indicated.]

Absorption, 61 : rate from intramuscular tissue.

Accommodation (eye), 47 : mechanism.

Acid : effect on enzymes of inflammatory exudates, 88 ; in test for pyrrol with naphthoquinon sodium mono-sulfonate, 60 ; changes sense of heliotropism, 49.

Adrenalin : rate of absorption from intramuscular tissue, 61 ; used for production of experimental arterio-sclerosis, 84. See epinephrin.

Agglutinable substance : decrease of production in bacteria, 51 ; ricin, 81.

Albumin, 85 : in castor bean. See ricin.

Alcohol, 49 : used to change sense of heliotropism.

Aleuronat, 88 : used for production of inflammatory exudates.

Alkali : accelerates reduction in the body, 59 ; in test for pyrrol, 60, and indol and skatol, 86, with naphthoquinon sodium mono-sulfonate ; changes sense of heliotropism, 49.

Amins, 60 : reaction with naphthoquinon sodium mono-sulfonate.

Anesthesia : influence on intraureteral pressure and peristalsis, 74 ; on blood specific gravity and viscosity, 91 ; produced with magnesium salts, 87.

Anesthetics, 49 : used to change sense of heliotropism. See anesthesia.

Anilin, 60 : reaction with naphthoquinon sodium mono-sulfonate.

Animals (of the experiments): *amœba*, 92 (II); *canary birds*, 52 ; *cats*, 64, 87 ; *dogs*, 57, 64, 69, 70, 74, 78, 80, 83, 87, 88, 90, 92 (III–V); *doves*, 50, 76 ; *fishes*, 70 ; *frogs*, 55, 64, 68, 70, 73, 76, 87 ; *guinea-pigs*, 62, 64, 76, 87 ; *men*, 57, 65 ; *mice*, 70 ; *mud-puppies*, 64 ; *opalinæ*, 76 ; *paramecia*, 72, 76, 92 (II); *poultry*, 52, 82 ; *rabbits*, 48, 58, 59, 61, 64, 67, 77, 84, 85, 87, 88 ; *rats*, 67, 76, 81, 87 ; *robins*, 50 ; *sheep*, 52 ; *shrimps*, 49 ; *sparrows*, 50, 64 ; *toads*, 64 ; *turtles*, 47, 55, 73 ; *vorticellæ*, 76, 92 (II); *worms*, 66. See parasites.

Anti-enzymes, 88 : in inflammatory exudates and normal serum.

Aorta, 84 : experimental arteriosclerosis.

Apparatus : for quantitative determination of reduction in the body, 59 ; for therapeutic application of radium, 54 ; new form of float for water or alcohol manometers, 56.

Arteriosclerosis, 84 : experimentally produced with adrenalin.

Atrophy, 83 : pathogenesis of acute yellow atrophy of the liver.

Atropin. See anesthesia.
Autolysis : inflammatory exudates, 88 ; liver, 48.

Bacteria : decreased production of agglutinable substance, 51 : effects of neodymium, præseodymium and lanthanum, 76.
Barium bromid, 92 (III and V) : effects compared with those of radium bromid.
Bile : effect on blood pressure and heart, 77 ; tetanic element, 68 ; toxicity, 68, 77.
Blood : in experimental measles, 65 ; parasites, 50, 64 ; precipitated and blackened by thorium salts, 69, 70 ; radioactivity after injection of radium, 92 ; *erythrocytes* — affected by malarial parasites, 50 ; agglutination by ricin, 85 ; protective action of concentrated solutions of venom against hemolysis, 63 ; *pressure* — influence of bile, 77 and of barium and radium, 92 (III) ; *serum* — anti-enzymotic power and enzymes, 88 ; *specific gravity*—narcosis, 91, and temperature, 90 ; *vessels* — experimental arteriosclerosis, 84 ; *viscosity* — influence of narcosis, 91, and temperature, 90.
Brain, 75 : protagon.
Breeding : hybrids, 82 ; Mendelian results, 52.
Brombenzol, 80 ; toxic and metabolic effects.
Brooklyn wells, 89 : growing danger of pollution.

Calcification : in experimental arteriosclerosis, 84 ; caused by thorium, 69.
Calcium chlorid, 66 : used to produce centrosomes in enucleated egg-fragments.
Carbamate of sodium, 78 : effects in dogs with Eck fistulas.
Castor bean, 85 : proteins, toxicity of ricin.
Cells : intracellular parasites, 50 ; structure of vaccine bodies in isolated cells, 67 ; variations in energy of growth in tumors, 81. See centrosome, degeneration, development.
Centrosome, 66 : formation in enucleated egg-fragments.
Chemical agents : affect virulence of tumor cells, 81 ; change method of development of frog eggs, 71, and sense of heliotropism, 49 ; effect "chemical fertilization," 79.
"Chemical fertilization," 79 : brought about with acids, salts, etc.
Chemical tests : indol and skatol, 60, 86 ; pyrrol, 60.
Chloroform. See anesthesia.
Cirrhosis, 83 : experimentally produced in the liver ; cause, etc.
Coatings of radium, 54 : method of preparation and therapeutic application.
Cocain. See anesthesia.
Composition, chemical : epinephrin, 53 ; liver, 48 ; protagon, 75 ; Brooklyn well-waters, 89.
Conjugation, 72 : rejuvenescence.
Conin, 60 : reaction with naphthoquinon sodium mono-sulfonate.
Crystalline lens, 47 : curvature and movements during accommodation.
Curare, 61 : rate of absorption from intramuscular tissue.
Cyanid of potassium, 81 : used experimentally to diminish energy of tumor growth.
Cystinuria, 80 : experimentally produced with brombenzol.

Decerebration, 74 : effect on ureteral conditions.

Decomposition products: epinephrin, 53; protagon, 75.
Degeneration: in experimental arteriosclerosis, 84, and cirrhosis, 83; caused by bile, 77, brombenzol, 80, and thorium, 69.
Development, 71: normal and abnormal embryos. See conjugation, fertilization.
Digestion: effect on ricin, 85; in inflammatory exudates, 88. See autolysis.
Di-indyl naphtho-ketone mono-sulfonate, 86: formed in new indol test.
Diphtheria toxin, 62: degrees of susceptibility influenced by heredity.
Diuretics, 74: effects on ureteral conditions.

Eck fistula, 78: feeding and injection experiments.
Eggs. See centrosome, development.
Embryos. See chemical fertilization, development.
Emerson's manometer float, 56: new form.
Enucleated egg-fragments, 66: formation of centrosome.
Enzymes, 88: in inflammatory exudates.
Epinephrin, 53: decomposition products, water of constitution. See adrenalin.
Erythrocytes. See blood.
Esters, 49: change sense of heliotropism.
Ether, 49; changes sense of heliotropism. See anesthesia.
Excretions: after treatment with brombenzol, 80, and thorium, 69; application of naphthoquinon sodium mono-sulfonate test, 60, 86; metabolism experiments — with gelatin, 57, with radium, 92 (V).
Exudates, 88: inflammatory; enzymes and anti-enzymes.
Eye, 47: mechanism of accommodation.

Fatigue, 55, 73: physical phenomena, temperature effects.
Fats (phosphorized). See protagon.
Feces. See excretions.
Fermentation, 92 (I): affected by radium rays.
Fertilization. See "chemical fertilization."
Fever, 58: reductions.
Fistula. See Eck fistula.
Float (manometer), 56: new form.
Fluorescein, 61: rate of absorption from intramuscular tissue.

Ganglia (heart), 77: effect of bile.
Gelatin, 57: substitute for protein in food.
Germination, 92 (I): affected by radium rays.
Glycerin, 81: used experimentally to diminish energy of tumor growth.

Heart: effects of bile, 71, and of barium and radium, 92 (III).
Heliotropism, 49: negative changed to positive in animals by chemical means.
Hematozoa, 50, 64; cultivation, differentiation. See parasites.
Hemolysis: not cause of toxic effects of bile on heart, 77; prevented by concentrated solutions of venom, 63.
Heredity, 62: influence on susceptibility to diphtheria toxin. See breeding.
Herter's apparatus for determination of reduction, 59: quantitative.
Hybrids, 82: poultry.

Indol: new reaction — qualitative, 60, quantitative, 86.

Infection; blood parasites, 50, 64; experimental measles, 65.
Inflammatory exudates. See exudates.
Inheritance. See heredity.
Inhibition, 77: bile on heart.
Injection experiments: adrenalin, 61, 84; arteriosclerosis, 84; barium bromid, 92 (III and V); bile, 68, 77; cirrhosis, 83; diphtheria toxin, 62; Eck fistula, 78; hematozoa, 50, 64; lanthanum salts, 76; liver, 48, 83; magnesium salts, 87; measles, 65; methylene blue, 58, 59; neodymium salts, 76; præseodymium salts, 76; radium, 92 (III–V); ricin, 85; thorium salts, 69, 70; tumors, 81.
Intracellular parasites. See parasites.
Intraureteral pressure, 74: relation to ureteral peristalsis; influence of diuretics, anesthesia, etc.

Kidney: influence of ureter on excretion of urine, 74; phosphorized fats, 75; radio-activity after injection of radium, 92 (III).

Lanthanum salts, 76: toxicology.
Lens. See crystalline lens.
Leukocytes, 88: digestive power in inflammatory exudates.
Leukocytozoa, 50: blood of birds.
Lieber's radium coatings, 54: methods of preparation and therapeutic application.
Liver: autolysis, and composition after subcutaneous injection of liver extracts, 48: experimental cirrhosis, 83; radioactivity after injection of radium, 92 (III).
Lumbar puncture. See anesthesia.

Magnesium salts, 87: cause anesthesia; toxicity.
Malarial parasites. See parasites.
Manometer float, 56: new form.
Measles, 65: experimental.
Meat extract, 78: effects in dogs with Eck fistulas.
Mendelian results, 52: breeding.
Metabolism experiments: barium, 92 (V); brombenzol, 80; Eck fistula, 78; gelatin, 57; radium, 92 (V).
Methods: change of energy of tumor growth, 82, sense of heliotropism, 49; culture and differentiation of hematozoa, 50, 64; determination of indol and skatol, 60, 86, intraureteral conditions, 74, pyrrol, 60; reductions in the body, 58, 59; experimental arteriosclerosis, 84; experimental cirrhosis, 83; extraction of fatty matter from kidney, 75; fertilization by chemical means, 79; production of anesthesia with magnesium salts, 87, centrosomes in enucleated egg-fragments, 66, inflammatory exudates, 88; radium coatings and application therapeutically, 54; to show decreased production of agglutinable substance in bacteria, 51, structure of vaccine bodies in isolated cells, 67, and tetanic element in bile, 68.
Methylamin, 53: obtained from epinephrin.
Methylene blue, 58, 59: used to determine reductions in the body.
Methylhydrazin, 53: obtained from epinephrin.
Morphin: influence on ureteral conditions, 74; rate of absorption from intramuscular tissue, 61.
Muscle: degeneration in experimental arteriosclerosis, 84; fatigue phenomena, 55, 73; influence of bile on heart, 77, and of various conditions on ureteral muscle, 74; *musculus retractor lentis* (Beer), 47; rate of absorption, 61; paralyzed

by thorium, 70, and by neodymium, præseodymium and lanthanum, 76; radioactivity after injection of radium.

Musculus retractor lentis (Beer), 47.

Naphthoquinon sodium mono-sulfonate: qualitative reactions and applications, 60; test for indol, pyrrol, skatol, etc., 86.

Narcosis. See anesthesia,

Neodymium salts, 76: toxicology.

Nephrectomy, 68: effect on toxicity of bile.

Nicotin, 60: reaction with naphthoquinon sodium mono-sulfonate.

Parabromphenyl-mercapturic acid, 80: elimination after brombenzol poisoning.

Paraldehyde, 49: changes sense of heliotropism.

Parasites: drepanidium, 64; filaria, 50, 64; hæmoproteus, 50; leukocytozoön, 50; malarial parasite, 50, 64; plasmodium, 50; spirochæte, 50; trypanosoma, 50, 64.

Pathological: absorption studies, 61; development in frog eggs, 71; experimental arteriosclerosis, 84, cirrhosis, 83, and measles, 65; hematozoa in birds, 50, and frogs, 64; inflammatory exudates, 88; protective action of venom upon blood corpuscles, 63; reductions in fever, 58; ricin, 85; tumors, 81; vaccine bodies, 67. See pharmacological.

Peristalsis, 74: ureteral.

Pharmacological: absorption from muscle, 61; anesthesia produced by magnesium salts, 87; barium bromid, 92 (III and V); bile, 68, 77; brombenzol, 80; Eck fistula, 78; lanthanum, neodymium and præseodymium salts, 76; radium bromid, 92; diphtheria toxin, 62; thorium salts, 69, 70.

Phosphorized fats, 75: from kidney and brain compared.

Physiological action. See pharmacological.

Piperidin, 60: reaction with naphthoquinon sodium mono-sulfonate.

Plants, 92 (I): effects of radium rays. See castor bean.

Præseodymium salts, 76: toxicology.

Protagon, 75: from brain and kidney compared — composition, preparation.

Proteins: effects in dogs with Eck fistulas, 78; gelatin substitute in food, 57; castor bean and ricin, 85; reactions with lanthanum, neodymium and præseodymium salts, 76, and with thorium salts, 69, 70.

Proteolytic enzymes, 88: inflammatory exudates.

Protozoa: absent from vaccine bodies, 67; rejuvenescence, 72. See parasites.

Pyrazolon (ring), 53: probably present in basic body from epinephrin.

Pyrrol, 60: reaction with naphthoquinon sodium mono-sulfonate.

Radioactivity, 92 (III): organs after administration of radium.

Radium: coatings and methods of therapeutic application, 54; effects of rays and bromid on animals and plants, and compared with barium, 92.

Reaction: effect on autolysis of inflammatory exudates, 88; in naphthoquinon sodium mono-sulfonate test for indol, pyrrol, etc., 60, 86.

Reductions: in fever, 58; measurement in the body, 59.

Rejuvenescence. See conjugation.

Resistance: bacteria against destruction in the body, 51; heredity on susceptibility to diphtheria toxin.
Ricin, 85: chemistry and toxicology.

Salts, 49: change sense of heliotropism. See pharmacological.
Skatol: obtained from epinephrin, 53; reaction with naphthoquinon sodium mono-sulfonate, 60, 86.
Specific gravity (blood). See blood.
Strychnin, 68: used to show tetanic element in bile.
Sulfur, 80: metabolism after administration of brombenzol.
Symptoms. See pathological and pharmacological.

Temperature: influence on phenomena of fatigue, 55, 73, on reduction in the body, 58, on virulence of tumor cells, 81, on specific gravity and viscosity of blood, 90.
Tetanic element in bile, 68.
Therapeutic, 54: application of radium.
Thorium salts, 69, 70: pharmacology, elimination, etc.
Toxicological. See pharmacological.
Toxin. See diphtheria toxin.
Trypanosomes: species, cultivation, etc., in birds, 50, in frogs, 64.
Tumors, 81: experimentally produced variations in energy of growth.

Ureter, 74: internal pressures and peristalsis, and their influence on urine flow; influence of anesthesia and diuresis on intraureteral conditions.
Urine, 74: influence of flow on intraureteral pressure and peristalsis, and *vice versa*. See excretions.

Vaccine bodies, 67: structure in isolated cells.
Venom, 63: protective action of concentrated solutions on blood corpuscles.
Virus, 65: experimental measles.
Viscosity (blood). See blood.

Water: of constitution in epinephrin, 53; of shallow wells in Brooklyn, 89.
Wells. See water.

PROCEEDINGS

OF THE

SOCIETY FOR

EXPERIMENTAL BIOLOGY AND MEDICINE

VOLUME II.

1904–1905

EDITED BY THE SECRETARY

NEW YORK

AUGUST 1, 1905

AMNH LIBRARY
100209742